Railway Mechanical Engineer

Volume 99 SEPTEMBER, 1925 No. 9

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PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE SIMMONS-BOARDMAN PUBLISHING COMPANY

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Washington: 17th and H Sts., N. W. New Orleans: 927 Canal St.
San Francisco: 74 New Montgomery St.
London: 34 Victoria Street, Westminster, S. W. 1
Cable Address: Urasigmec, London

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Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Request for change of address should reach the New York office two weeks before the date of the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, be sure to send us your old address as well as the new one.

Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00. When paid through the London office, 34 Victoria Street, S. W. 1, 17s. 0d. Single copy 35 cents or 1.6d.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulation (A. B. C.).

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Railway Mechanical Engineer

Vol. 99 September, 1925 No. 9

Just how can the best use be made of the *Railway Mechanical Engineer?* Each number is brimful of constructive suggestions and facts which are of vital interest to mechanical department officers and foremen. We have had a number of requests in recent months for suggestions as to the subjects to be discussed at staff meetings or before foremen's clubs. After the August issue of the *Railway Mechanical Engineer* was mailed we wrote to the author of the letter on page 495 which is signed "Output." Here is an extract from his reply. "As you probably know, one of ———'s methods of keeping his foremen from senile decay is to mark an article in some mechanical magazine and request a paper as to its merits to be read at one of the foremen's meetings. That is the way 'Output' came to life." We find that a growing number of master mechanics, shop superintendents and general foremen are adopting the practice of referring to different articles in the paper and asking those associates whose departments the articles concern, to express an opinion as to the value of the articles and their application to their peculiar conditions. Indeed, there are superintendents of motive power who regularly ask some of their subordinates for opinions on articles which are published in the technical papers or on addresses or reports that are made before railroad clubs or technical associations or societies. There is much to commend this practice. It stimulates and inspires officers and foremen to crystallize their thinking and to search out and adopt the very best methods and practices. Where the reports or findings are presented at a meeting of the foremen or local officers, the resulting discussion is quite likely to develop features and improvements which were not mentioned in the original articles or suggested by the man reporting upon it. There is always great value in open and full and free discussion on matters of this kind. We hope that more and more of the mechanical officers will use the *Railway Mechanical Engineer* in this way.

Using the Railway Mechanical Engineer

The third prize article in the *Railway Mechanical Engineer* competition on the foreman and his responsibilities appears elsewhere in this number. It was written by J. W. Murphy, general foreman of the Boston & Albany at West Springfield, Mass. Mr. Murphy approaches the question in a very different way from "Bill Brown" in the first prize article, which was published in our June number and which seems to have started a real controversy; nor is the treatment similar to that of the second prize article by John Linn of the Santa Fe, which was printed in our August number.

The foreman's responsibility

Mr. Murphy's article challenges attention from several viewpoints. We often hear it said that a cause or an organization cannot stand still; it must go forward or backward. To what extent is it true that foremen, when once appointed to that position, settle down to routine work and fail to make an effort to keep abreast of the times and to improve themselves by study and observation in order to give a larger service to their employers, as well as the men under them, and to fit themselves for larger responsibilities? If they do stand still they will go backward, for the entire conception of relations in industry and transportation has been changing and is steadily rising to higher ideals. Mr. Murphy indicates that a foreman should "make himself more fit each day to render that service in the most effective way." The inference is that the foreman, whether newly appointed or old on the job, should constantly study and strive to make his efforts more effective; otherwise he will stagnate and fail in his duty to his employer, the employees and the public. Is this conception too idealistic? In a way it agrees closely with the underlying spirit of the other two prize winning articles by "Bill Brown" and Mr. Linn. Practical results are what we are after in this materialistic age. Can they be secured by foremen who are dominated by a spirit of service to their fellows?

When scheduling systems for repair work were first introduced in railway shops, they were looked on with a great deal of skepticism by the supervisory forces. They were considered the brain child of some efficiency expert who did not know the true conditions of the shops. But, after a great deal of explaining and persuasion, these same sceptics began to realize that those responsible for the introduction of shop schedules did know the true condition of the shops and were trying to bring order out of chaos. In order to increase production, reduce repair costs and still maintain quality of workmanship, a system must be devised whereby every department, every supervisor and every workman must know what to do, when to do it, and how to do it, so that the system may properly function. One of the problems facing the mechanical officers today is to lessen the large amount of unessential detail work with which the average shop foreman has to contend. It is obvious that attention to details which can better be handled automatically by system is not the function of the foreman and besides it is absolutely impossible for one man to know intimately all the details of the work carried on in a large railroad shop. By making each workman or group of workmen in each craft responsible for the completion of a certain job at a predetermined time, the supervisory officers are relieved of a mass of details enabling them to give their attention to the more important problems of personnel and organization. A

Purpose of shop schedules

scheduling system which functions properly, will quickly indicate what departments need strengthening. The schedule boards indicate infallibly where delays periodically or persistently occur. Friction between departments is almost entirely eliminated as it is not possible to unload on one department causes for delay which belong to another. Thus, it can be said that scheduling eliminates one of the human frailties of "passing the buck to the other fellow"—as the constant reappearance of the daily delay report stimulates foremen and workmen to establish a record of performance on merit alone instead of concealing their deficiencies at the expense of their fellow workmen.

Locomotive efficiency improves

At the World's Fair held in St. Louis in 1904, several types of locomotives were given exhaustive tests in a newly designed test plant constructed as a part of the Pennsylvania Railroad exhibit. The official report of these tests was published in 1905, exactly 20 years ago, and an interesting and highly illuminating indication of the advance in locomotive design and construction since that time can be obtained by comparing the figures then obtained with locomotive test plant results secured in 1925.

One of the locomotives tested at St. Louis in 1904 was a heavy Consolidation type designed for freight service and considered thoroughly modern at that time. For purposes of comparison, the Missouri Pacific three-cylinder Mikado type locomotive, which was tested at the Altoona test plant during the past year, may be selected. The Consolidation weighed 173,000 lb. on the drivers and developed a maximum drawbar pull of 22,078 lb., as opposed to 244,500 lb. weight on the drivers and 61,847 lb. drawbar pull for the Mikado. In other words, while the weight on the drivers of the modern locomotive has increased 41 per cent, the drawbar pull available for hauling freight trains has increased 180 per cent or nearly trebled.

The effect of improved modern locomotive design on the coal pile is strikingly manifested by the relative figures for coal consumption. The 1905 Consolidation consumed from 2.9 to 5.4 lb. of dry coal per indicated horsepower hour dependent upon the load conditions, as against 2.1 to 3.8 lb. for the 1925 three-cylinder Mikado. It will therefore be observed that the coal consumption per unit of power developed is decreased almost one-third in the modern locomotive.

The real significance of what locomotive designers have accomplished, however, is shown in a comparison of the figures for efficiency. The maximum boiler, machine and overall efficiencies of the Consolidation were 78.9, 84.8 and 5.1 per cent respectively, the corresponding efficiencies for the three-cylinder Mikado being 83, 92 and 7.3 per cent. The designer's work in getting increased utilization of the heat in the coal is indicated by this increase of 4.1 per cent in boiler efficiency. In spite of the increased size, weight and complication of the modern locomotive with consequent increased frictional losses and lubrication difficulties, the machine efficiency has been increased 7.2 per cent. The increase of 2.2 per cent in overall efficiency while small numerically means a saving of many thousands of tons of coal annually.

The statement is made that many mechanical department officers deprecate the ultimate economy of fuel-saving accessories on locomotives and do not favor the application of these devices because they add to the cost of maintenance and increase the possibility of failures on the road. That any considerable number of mechanical department officers hold this view may well be doubted, for ample evidence is available that the practice of many railroads in applying these devices has paid big returns on the investment. With present fuel and labor costs, it pays to utilize the most efficient locomotives available.

The opinion of one enginehouse foreman regarding the improved performance of modern locomotives is indicated in the following unsolicited comment: "If the modern locomotive were as wasteful of coal as its predecessor of 20 years ago we would have to hook a coal car on behind the tender to carry the extra fuel." This statement is an exaggeration which, however, shows the real opinion of a railroad mechanical officer who sees the effect of improved locomotive design including fuel-saving devices on the coal pile. The question may well be asked, "How many of those old 1905 locomotives are still in operation?" With the modern locomotive consuming one-third less coal per horsepower hour developed than is being burned by locomotives of earlier and relatively inferior types, it is plain that the latter should be retired as fast as possible or rebuilt and thoroughly improved.

Foremanship training

The chamber of commerce at Milwaukee, known as the Milwaukee Association of Commerce, has for several years conducted a Foremen's Safety School under the direction of the Safety Division of the Association. The success of the school, the work of which is outlined in a communication on another page of this issue from Harry J. Bell, manager of the Safety Division, is undoubtedly due in a large measure to the broad and comprehensive way in which this whole problem of safety has been approached. Indeed, the people in Milwaukee in referring to the work of the school characterize it as "wholesaling safety." The theory on which it is based seems to be that real progress can be made not by treating a disease, but by getting at the fundamental causes and eliminating it entirely. The purpose therefore seems to be not to go into a lot of details as to the prevention of accidents, but rather to improve the leadership ability of the foremen, in order that they may help and inspire the men to a larger and more intelligent interest in their work. This is reflected in better morale and greater efficiency. It means also that the foremen must understand thoroughly the fundamental principles affecting production, employment, labor turnover, leadership, etc. It is understood that a number of railroad foremen have taken this course or are enrolled in it. It would be interesting to know just what benefits they have received in the direction of improving their leadership ability.

Are there not many other industrial communities in which large railroad shops are located where the Milwaukee method could be reproduced to advantage by getting the local chamber of commerce or other civic bodies interested? The industries and the railroads have a common problem to solve. The principles underlying successful foremanship are the same in both fields and getting the foremen together to discuss these principles, where it is possible, might bring about a closer and more cordial relationship between the railroads and the industries in the particular community.

There is also another public source from which some of the railroad groups can undoubtedly receive help in foremanship training. Reference was made in the survey on foremanship training in the June number of the *Railway Mechanical Engineer* to the study course which is being followed by the foremen of the Lehigh Valley at Sayre, Pa., which was furnished by the Engineering Extension Department of State College, Pennsylvania. Some of our friends in the Grand Trunk Western shops at Battle Creek, Mich., have advised us that a representative of the Department of Industrial Education of the

University of Michigan conducted a most effective course in foremanship training in Battle Creek last year. Undoubtedly a goodly number of the other state universities are prepared to give assistance in this direction. Indeed, an open forum discussion on foremanship training at the Railroad Y. M. C. A. Summer School at Blue Ridge, N. C., last month developed the fact that two Railroad Y. M. C. A. secretaries are negotiating with representatives of state universities to help them put on such a course this next season for the foremen and supervisory officers in their particular localities. One of these Y. M. C. A. secretaries is located in New Hampshire and the other one in Georgia. The Industrial Department of the Y. M. C. A. has also promoted courses on foremanship and many of the larger Y. M. C. A's throughout the country include such courses in their educational program.

It is evident that a number of railroads are going to tackle this problem seriously during the next season; there are several ways in which to approach this task, depending upon local conditions and available facilities. The above suggestions cover only a few of the possible approaches.

New Books

LAYING OUT FOR BOILER MAKERS: *Fourth edition, revised.* 8½ *in. by* 12 *in.,* 385 *pages,* 550 *illustrations. Published by the Simmons Boardman Publishing Company, New York. Price* $8.00.

The fourth edition of this book, which has been well known for many years in the field of boiler making, has been completely revised and amplified. New chapters have been added on the layout of return tubular boilers and on the locomotive boiler. These chapters were specially prepared by authorities on the subject and are the last word in modern layout practice. The principles of triangulation and projection are discussed in the opening chapter of the book and applied to practically every form of layout work that is required in a modern shop. A chapter is devoted to marine boiler construction with the practice of one of the largest shipyards in the country taken as a basis. A chapter is devoted to layout problems, including uptakes, Y problems, stacks, tanks, breeching, tapering sections, chutes, buoys, transition pieces, pipe layouts, elbows, hoppers, hoods, ventilators and numerous other miscellaneous problems. The book has been divided into fourteen chapters and these have been completely cross-indexed for ready reference to any problem that might come up in the course of work in nearly any plate or boiler shop.

THE RESISTANCE OF EXPRESS TRAINS, *by C. F. Dendy Marshall, M. A. Bound in cloth,* 9 *in. by* 12 *in.,* 86 *pages,* 55 *illustrations and diagrams. Published by the Railway Engineer, London, Eng. Price* 20 *shillings.*

The subject of train resistance is extremely interesting and of practical importance to railroad men. Although considerable experimental work has been performed relative to this problem comparatively little that has been written about it has been published in book form. The author, in writing this book has sought to provide a book from which the important results of numerous tests and experiments may be obtained.

The book contains 17 chapters including such subjects as internal resistances of cars, track resistance, effect of acceleration, gradients, curves and winds. There are five chapters devoted to the discussion of wind resistance in which the effect of oblique winds, direct winds and resultant winds are considered. Three additional chapters are also included in which the author has reviewed the recent developments and findings on train resistance, a summary of formulas, and a description of the dynamometer car used on the Great Western Railway of England.

The author has made a number of suggestions relative to new lines of experiments which can be followed without much difficulty. He has also described a number of modifications applicable to standard practice that are aimed to bring about better running conditions and economy in the use of fuel. Although the book is written primarily from the standpoint of railway practice in Great Britain, practically all of the conditions described and the treatment of the various problems of train resistance are applicable to railway practice in this country.

What Our Readers Think

Who can answer this question?

OMAHA, Neb.

TO THE EDITOR:

We have recently had several inquiries relative to the following question: "How does fire affect steel underframes of box cars that have had the woodwork burned off?"

I have been trying to procure information relative to this from several railroad men, but they have not had any experience that would warrant their giving me any authentic information. As the *Railway Mechanical Engineer* is in a position to gather the latest that is to be obtained in railroad practice, I am appealing to you. Can you help me?

F. W. BASON.
Manager, Railway Educational Bureau.

Reclaiming asbestos locomotive lagging

MINNEAPOLIS, Minn.

TO THE EDITOR:

I am a reader of your magazine and have found many valuable and interesting articles for locomotive and car men of a practical nature. I notice also that a good many questions are answered by the readers as well as the editorial staff, and this leads me to ask for a practical method of reclaiming asbestos locomotive lagging. My principal trouble seems to be in applying sufficient pressure in moulding the new blocks, and I would appreciate any suggestions along the lines of a practical home made press.

THEO. NYGREN,
Locomotive carpenter foreman, Soo Line.

Treated water and firebox renewals

DECATUR, Ill.

TO THE EDITOR:

I have just read with interest the editorial in the August *Railway Mechanical Engineer* relative to the service given by a firebox on a Pacific type locomotive on the Southern Pacific, the firebox having lasted somewhat over 12 years and the unusual length of service being attributed to hot water washing of boilers and treatment of feedwater.

I think there are few that realize the possibility of increasing firebox life through hot water washout plants and particularly through the use of treated water. Below are statistics in regard to firebox life on some of the

larger Wabash class of power and which may be of interest to the readers of the *Railway Mechanical Engineer*.

Our firebox renewals are very light and we attribute this almost entirely to the fact that all locomotive boiler water used on the railroad is treated, with the exception of the few waters that contain a little natural sodium carbonate or soda ash. Our method is to treat the water at the roadside supply tank with enough soda ash to neutralize any sulphate hardness in the water and provide a slight excess of soda ash. The treatment was started in 1912 and extended gradually until it was completed in 1916.

In 1912 we purchased 16 Pacific type passenger locomotives with 24-in. by 26-in. cylinders, total weight of engine and tender 423,840 lb. Only six of these have received fireboxes and three of them were applied before treated water was used on the divisions on which they were running. In the same year 63 Mikado locomotives were purchased with 26-in. by 30 in. cylinders, weight of engine and tender 423,840 lb. Of these 63 engines, some of which were run for several years without treated water, only eight have received fireboxes, and these eight were applied in 1915 when they were converted from saturated steam engines to superheated engines, it being thought advisable when we first started converting the engines to apply complete fireboxs. This practice was soon stopped and no fireboxes have since been applied to this class of locomotive.

Thirty heavy six-wheel switch engines were purchased in 1906 and 1907 and 12 similar engines in 1912. Six of the first 30 have received fireboxes but none of those purchased in 1912.

In 1917 twenty-five Santa Fe type locomotives with 29-in. by 32 in. cylinders, weight of engine and tender 592,000 lb., were placed in service, and none of these have received fireboxes or even part side sheets. These Santa Fe type locomotives have 96-in. by 120 in. fireboxes and 60-in. combustion chambers.

The very large increase in firebox life is only one of the advantages that can be obtained by water treatment, but in order to obtain the full advantage of the treatment for locomotives over any certain operating district all water that is used by them must be treated by some method that will result in the water in the boiler always showing an excess alkalinity.

W. A. Pownall,
Mechanical Engineer, Wabash Railway.

Foremen's safety school

Milwaukee, Wis.

To the editor:

The Milwaukee Association of Commerce organized, in 1920, the first full-time, budget-supported safety division in chamber of commerce history. During nearly five years of intensive operation the activities of this division have expanded to embrace practically every large employer of labor in Milwaukee and its environs; it is, furthermore, having a noteworthy effect upon industrial conditions throughout Wisconsin. Certain of its projects have attained the proportion of national institutions. An instance in kind is its Foremen's Safety School.

Proceeding on the unquestionably sound premise that 85 per cent of *industrial accidents are preventable by education,* and cognizant of the important position occupied by foremen in the modern industrial structure, this school was conceived as a means of "wholesaling" safety to the entire industrial community. It is now in its fifth season and has an enrollment of 4,538—principally foremen and forewomen. Attendance at its meetings averages 3,000!

The school each year holds six monthly gatherings and is divided into sectional meetings and general sessions, all held in the evening in the Milwaukee Auditorium, a building which is particularly suited to this purpose. Sectional meetings, in session from 7:45 to 8:30, are devoted to addresses and practical discussion of the specific, semi-technical subjects in hand, while the general sessions, from 8:45 to 9:30, are given over to speeches of universal appeal and inspirational in character. During the fifteen minute intermission between the sectional and general meetings, an industrial band provides entertainment. Exhibits, demonstrations, stereopticon and moving pictures all contribute to the success of the plan.

The school is sectionalized by industrial grouping as follows: Machine shop, sheet metal, packers and tanners, woodworking, building construction, foundry, electrical and all-trades, the latter being arranged to provide for those industries not specifically included in the special trade sections. These sections meet in eight separate halls during the forepart of the evening and join in the general meeting for the remainder of the evening. Each person enrolled is given an attendance card which is perforated to indicate presence at meetings, a master record of enrollment and attendance being maintained at the headquarters office.

Thus, with the very minimum of effort and expense, the school provides an opportunity for employers to take advantage of a constructive educational plan of tremendous value to executives and supervisors in general *and foremen in particular. For the school deals, in an altogether practical manner, with such important aspects of industrial betterment as accident prevention, production, employment, labor turnover, fire prevention and leadership.* How important it is that serious, earnest effort be directed to these problems is illustrated by the fact that Wisconsin in 1923 had 20,941 compensation cases, costing $3,719,030 and that its fire loss that year was $11,500,000!

The concluding meeting of the school takes the form of a graduation banquet at which certificates are awarded to those who meet the requirements laid down by the committees in charge of this operation, composed of 54 representatives of our leading industries. The graduates of the school now number over 4,000 and it is expected 2,000 more will graduate from the present school.

This project, like the sundry other operations of the Safety Division, is designed to develop a sense of responsibility on the part of the foremen for the safety and well-being of those who work under his direction; to inculcate in his mind a high regard for the principles and practices of safety and to make him understand that safety increases efficiency, improves morale, decreases material spoilage and aids production. That accidents are not a necessary by-product of industry and, consequently, it becomes the duty of the foreman not only to practice safety himself, but to teach it by example and precept to those with whom he has contact.

The dynamic force behind the work of the Safety Division is Frank Frey, Jr., of Geuder, Paeschke & Frey Co., manufacturers. Mr. Frey, as Chairman of the Division, is a member of the board of directors of the Association of Commerce. The Association is in affiliation with the Chamber of Commerce of the United States, the National Safety Council and the National Fire Protection Association. The extent of co-operation necessary as a means of obtaining results in its various operations, is evidenced by the fact that 71 speakers from various sections of the United States will address the sundry meetings functioned under the Division's 1924-1925 program of activities.

Harry J. Bell,
Manager, Safety Division, Milwaukee Association of Commerce.

The foreman and his responsibility

Third prize article in the competition recently held by the Railway Mechanical Engineer

By J. W. Murphy
General foreman, Boston & Albany, West Springfield, Mass.

THE foreman in any industrial organization is a connecting link between the management and the worker, and upon the character of this link depends not only the success of the whole organization, but of the foreman himself. Essentially the foreman's job is to direct his men in such a way as to obtain the greatest possible production, quality considered. The manner in which he accomplishes this object, however, has a tremendous bearing upon the soundness of the entire organization, and the cordial relations between the management and the employees.

The foreman is confronted daily with problems of a technical nature and of human relations. The first he can solve if he is thoroughly conversant with his trade, and the second if he is a real man with his heart in the right place. No man should ever consider accepting a foreman's job unless he is willing to assume the responsibility that goes with it. The national game of "passing the buck" which was so prevalent among railroad men is being eliminated, for men are coming more and more to the realization that a great deal of material and spiritual satisfaction is gained—that bigger things are in store—if the game of life is played honestly.

J. W. Murphy

Must have an ideal

A successful foreman must have an ideal and strive in the daily routine to attain that ideal; otherwise he will be a failure. There is no such thing as luck; if we look into the lives of great men we will find that all of them had an ideal in life and worked hard to realize it. That is why they were successful in whatever walk of life they moved.

The question then arises, what should be the railroad shop foreman's ideal and what should he do to attain it. His ideal should be that of service; service to his management, the public, to his workers, and to himself. His position is big, bigger and more important than that of some of his executives, for he has a broader field to serve and a great deal more is required of him. Because of this he should be fit to handle the job and make himself more fit each day to render that service in the most efficient manner.

Much has been said and written about applying the "Golden Rule," but the "Golden Rule" alone will not solve all problems; neither will it make good foremen. In my opinion there are three outstanding features which make the successful foreman and these are:

1. Certain characteristics of leadership.
2. A thorough knowledge of his trade and keeping abreast with new developments in his line.
3. Honesty to the management, to the employees, and to himself.

Must be a leader

The first of these requirements is obvious. In order to direct his men to efficient production he must be a leader, either born or developed by proper training. This is especially desirable in a railroad shop where, due to the nature of the work, systematizing is more difficult than in an industrial plant; hence more responsibility devolves on the foreman. A foreman who possesses the quality of leadership is able to organize and place his men so as to obtain maximum production with the facilities at his disposal. In many of our railroad shops today too little attention is paid by the foreman to physique, psychology, or natural aptitude of the workers. If a foreman does not give sufficient serious consideration to these characteristics of the worker, he is soon confronted with the problem of "lost motion" in his department and oftentimes he cannot locate the cause. If he would only study his men he would soon find that they work most efficiently when placed on jobs for which they have a natural aptitude. In everyday routine the average foreman does not pay much attention to these things, but the successful foreman does. A foreman who is a leader with an ideal will imbue his ideal and enthusiasm in his workers and thus develop a dependable man and an efficient organization.

A man, to be a successful foreman, must have a thorough knowledge of his trade. This is essential in order to perform his duties properly and hold the respect of his men. The type of man which is needed in our railroad shops today as foreman is one who will give a direct answer to any question pertaining to the technical side of

his work, for there is nothing which will cause a worker to lose respect for his foreman more than stalling when the answer should be forthcoming quickly. A foreman should take a broad view of his position; be open-minded in regard to new improvements and methods. The successful foreman is never the self-satisfied, know-it-all type of man. He is the man who, realizing his deficiency of knowledge on certain subjects, will study them. He is the man who will keep himself informed on new developments in the mechanical end of railroading by means of books and periodicals dealing with these subjects. By doing this he is making himself more valuable to the company, to his workers, and to himself.

Human relations

The question of human relations in a railroad shop is one of vital importance to the organization and there is no official who can do more to further good-will than the foreman. When all industry was in its infancy, it was not uncommon for the owner or manager to mingle with the workers where each could exchange his point of view and promote good relations. Today in our complex industrial organization, this is impossible and it devolves upon the foreman to familiarize himself with the policy of the management and convey this to the worker. It is up to the foreman to dispel all rumors or misunderstandings in regard to the management; it is up to him to respect and speak well of his superiors, for in this way his men will develop a respect for the offiicals and for the foreman himself. The management knows that the application of the "Golden Rule" is for the good of all concerned, but the foreman is the man who must, and the only man who can, put it across in a practical way.

What is there in a railroad shop to keep a man content and interested? He has a certain fixed rate of pay which he cannot exceed, so there is no incentive in that direction. He may become a foreman, but he has no illusions in that respect, for one in a hundred may be promoted and the opportunity does not come very often. Why doesn't he stagnate? The thing that keeps him moving is the dynamic force of good relations between his management, his foreman, and his fellow workers. The successful foreman realizes this and puts all his efforts to promote the good relations, and wherever possible to improve working conditions and make life in the shop as pleasant as possible. The successful foreman is a real man with a soul and a heart in the right place, who never forgets that his men are human and have hearts and souls. He is not the man who peddles gossip or petty little reports to his superiors, but looks on his job in a big way; in an honest and manly way.

What is the foreman going to gain by putting his best efforts into the daily grind when just "getting by" is so easy; when shirking certain responsibilities relieves him of so much strain; when "passing the buck" is so pleasant a game. The foreman's gain is twofold. First, he has the moral satisfaction that he is playing the game right; and second, when the opportunity for promotion comes it is always the man who has been doing his duty honestly every day who gets the promotion, for after all, real achievement is an accumulation of hard, earnest everyday work.

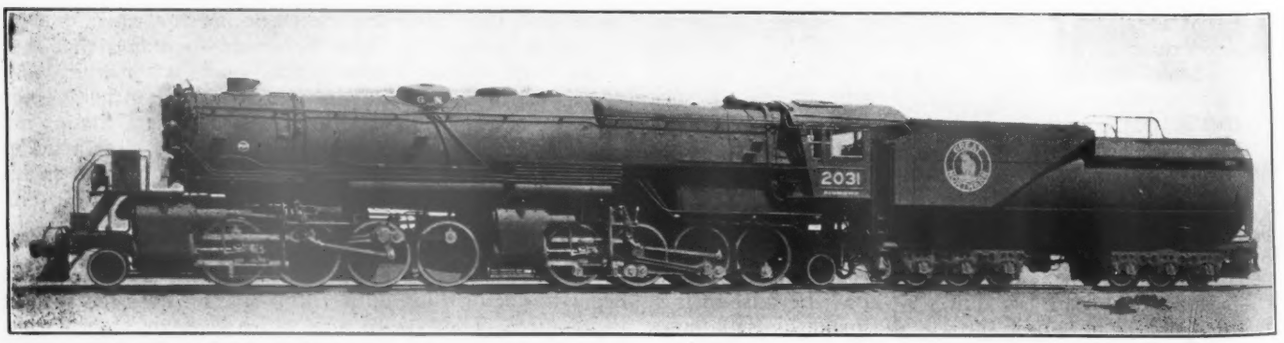
We must not forget, however, that the individual foreman alone cannot build the whole organization; that there must be co-operation from the president down; that there must be co-operation among the foremen, that the petty little jealousies among them must cease, for in the final analysis nothing is gained by them.

Which is going to succeed, stagnation or progress? I'll leave it to the foremen to solve the riddle.

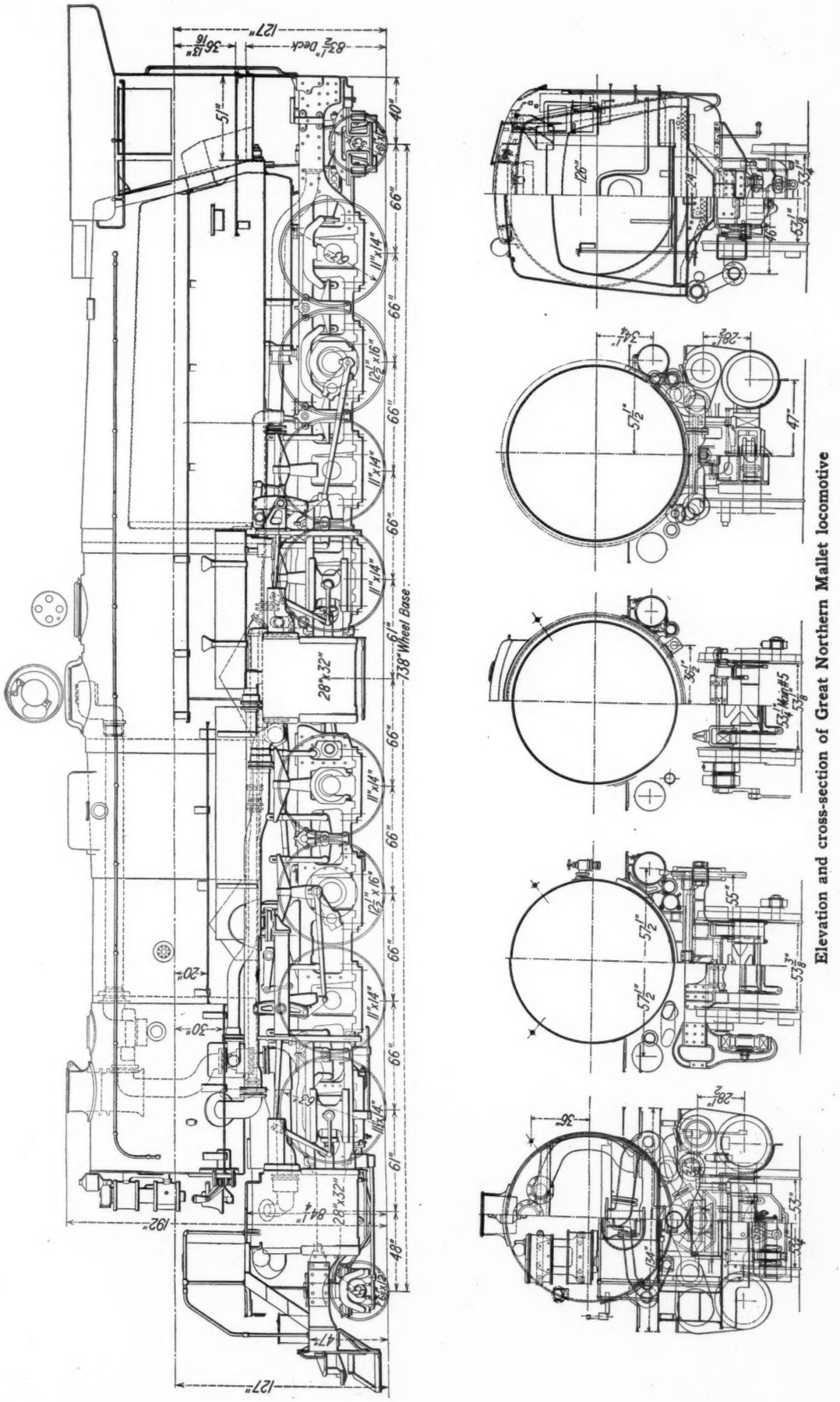
Mallet locomotives acquired by Great Northern

THE Baldwin Locomotive Works, Philadelphia, Pa., recently delivered to the Great Northern four articulated locomotives of the 2-8-8-2 type. These locomotives, designated by the Great Northern as Class R-1-S, are intended for operation between Cut Bank and Whitefish, Montana, a distance of 128 miles, where the line crosses the continental divide. The ruling grade approaching the summit west-bound is one per cent, while east-bound it is 0.8 per cent with a pusher grade of 1.8 per cent, 13.8 miles long. The elevation at the summit is 5,211 ft. The sharpest curves on this section of the line are of 10 deg. although the locomotives are designed to traverse curves as sharp as 20 deg.

Since the latter part of 1923, the heavy freight traffic on this division has been handled principally by locomotives of the 2-10-2 type, which were built by the Baldwin Locomotive Works. These locomotives develop a tractive force of 87,100 lb. Four of them, which are equipped with boosters, giving a maximum starting tractive force of nearly 100,000 lb., are used as pushers on the 1.8 per



Great Northern Articulated locomotive which weighs, with tender, 916,500 lb. and develops a tractive force of 127,500 lb.



Elevation and cross-section of Great Northern Mallet locomotive

cent grade. As compared with the road engines of the 2-10-2 type, the new articulated locomotives show an increase in tractive force of nearly 47 per cent.

The largest articulated locomotives heretofore used by the Great Northern are the 25 Mallet compounds of the 2-8-8-0 type, known as Class N-1, which were built by the Baldwin Locomotive Works in 1912. During the past year a number of these locomotives were changed to use high pressure steam in four equal sized cylinders, and the design of the new locomotives was determined after experiments had proved that a material increase in hauling capacity was thus obtained. Track conditions on the Great Northern have been much improved since the Class N-1 locomotives were constructed, and with the wheel loads now permitted it is possible to apply a boiler of sufficient capacity to insure an abundant supply of steam for the four 28-in. by 32-in. cylinders used on the Class R-1-S.

The total weight of these locomotives is 594,940 lb. of which 532,800 lb. is on the drivers, 37,550 lb. on the front truck and 24,590 lb. on the trailing truck. The diameter and stroke of the cylinders are 28-in. by 32-in.; the diameter of the driving wheels is 63 in. With 210 lb. steam pressure and 65 per cent cut-off, a tractive force of 127,500 lb. is developed.

Boiler and equipment

In accordance with the usual practice on this road, the boiler of Class R-1-S is of the Belpaire type. The barrel has a conical connection, and is 100 in. in diameter at the front end, the maximum diameter being 109 in. It is fed by one Sellers non-lifting injector placed on the left side, and by one Elesco exhaust steam injector on the right side. The combustion chamber has a length of 72 in. and the tubes are 24 ft. long. The locomotives, as built, are equipped for oil burning, but the design is so worked out that they can subsequently, if desired, be equipped to burn coal and fitted with arches and mechanical stokers. At present no arch tubes are applied, but a brick wall is placed across the throat of the combustion chamber.

Flexible staybolts are applied in the breaking zones in the sides of the firebox. Hollow stays are used in the back head and back of the brick work and there is a complete installation of flexible bolts in the firebox throat and the combustion chamber.

The main dome is on the third boiler ring, and back of it on the same ring, is a man-hole opening fitted with a depressed cover in which are mounted the whistle and the four safety valves. This arrangement was necessary in order to keep within the over-all height limit.

A throttle valve of the Baldwin balanced type is placed in the main dome, and is connected with the superheater header in the smokebox by means of an internal dry pipe. The steam pipes leading from the superheater header terminate in a second header, placed transversely in the bottom of the smokebox and having connections with two outside steam pipes which lead back to the rear cylinders. The front cylinders receive their steam supply through a centrally located pipe connected to the same header, and having three ball joints. All slip and ball joints are lubricated; oil cups are used on all the packing on the locomotive.

The exhaust from the two front cylinders is conveyed to the nozzle through a pipe placed on the center line and fitted with two ball joints lubricated with oil and one slip joint lubricated with grease. The exhaust pipe from the rear cylinders is placed on the left side and it terminates in an annular opening surrounding the exhaust nozzle of the front cylinders. The steam supply for the Elesco exhaust steam injector is taken from the exhausts of both the front and rear cylinders. This injector is placed under the cab on the right-hand side.

Frame construction and running gear

The frames are 6 in. wide and are spaced 41 in. apart transversely. Special attention has been given to the design of the articulated frame connection. The vertical hinge pin is 6 in. in diameter and is held rigid in the rear cylinder saddle, being secured from turning by a tapered fit and a heavy tapered key. The saddle is bushed and the pin is case-hardened. By holding the pin rigid the wear is taken by the bushed connecting bar, which can be easily rebushed and thus the slack between the two units can be kept at a minimum. Both the vertical and horizontal hinge pins are internally lubricated with grease, which is applied from an easily accessible outside location.

The four cylinders are cast iron and are interchangeable, as are also the front and back pistons, crossheads and connecting rods. Corresponding crank pins, wheels and axles in the front and rear units interchange also. The steam distribution is controlled by 14-in. piston valves which are operated by the Walschaerts valve gear. A Ragonnet, Type B, power reverse mechanism is applied. The reach rod connecting the front and back reverse shafts is placed on the center line of the locomotive with its joint immediately above the articulated frame connection. In this way there is practically no distortion to the movement of the forward valves when the locomotive is traversing a curve. The valves all have 1⅞ in. steam lap and no exhaust clearance and are set with a travel of 6¾ in. and a lead of 3/16 in. The cut-off, when working in full gear, is 65 per cent.

The piston heads are steel of the solid type, fitted with bull rings and packing rings of Baldwin Locomotive Works special iron. The main crank pins are of vanadium steel, hollow bored. With the exception of the front main rod stubs, solid end stubs with floating bushings are used throughout. All the pins are lubricated by means of grease.

The boiler is supported on the front frames by means of a single bearer, located to give an even weight distribution and designed to distribute the load on the frames with a minimum frame stress. A low bearing pressure per square inch is assured by the liberal bearing area provided, and the bearer is designed to permit a rocking movement of the frames without binding. No centering device is applied, experience having proved that its use is unnecessary. The upper castings of the bearer and of the rear cylinder saddle are riveted to the boiler, the liners being placed outside the shell. The forward equalization divides between the second and third pairs of drivers, thus giving a three-point suspension for the front unit.

The front and rear trucks are in many respects similar in construction and have interchangeable wheels and axles. The front truck is center bearing and the rear truck side bearing, the bolsters in each case being suspended on heart shaped links. The transverse distance between the inside faces of the truck tires is 5¾ in., while for the driving tires, it is respectively 53, 53⅜, 53¼ and 53⅛ in. for the first, second, third and fourth pairs of drivers of each group. Flanged tires are used on all the wheels.

Arrangement of the cab

The cab is located sufficiently far back to place all flexible stay-bolts outside, where they are easily accessible. To provide clear vision for the enginemen, the front cab windows are placed in specially designed brass frames which permit the glass to extend the full width of the front panels. Steam piping immediately forward of the cab is placed under the jacket; and this, together with the downward trend of the running boards as they extend forward and the arrangement of all external fittings, gives

the engine crew as clear a vision as can be obtained in a locomotive of this size and type.

These locomotives are equipped with force feed lubricators for the front cylinders, and with flange oilers on the leading drivers of both the front and back units. A drifting valve with the handle conveniently located in the cab, and having a 2½-in. pipe connection to the steam valve stand, supplies steam to the cylinders when drifting. The main steam valve stand is placed on the roof sheet in front of the cab, and there is also an auxiliary steam manifold on the left side of the back head connected to the steam valve stand and serving the blower in the smokebox, the oil atomizer, tank heater, oil heater, cab heater, sprinkler, flange lubricator heater and the force feed lubricator heater. On the right side of the back head is an air manifold, with valves serving the bell ringer, sanders, cylinder cocks for the front unit and cylinder cocks for the back unit. This manifold also has plugged connections for the fire door, tube cleaner and whistle.

The oil burning arrangement has a number of interesting features. The damper controlling the intake of air through the fire pan is automatic in its action, opening by draft and closing by gravity. The fire door is provided with an intake riser through the deck, thus preventing cold air from being drawn into the cab. The firebox has a brick flash wall in the back and all firebox seams are protected from the direct action of the fire by seam fire brick.

In order to prevent the exhaust from the air compressors from drawing on the fire when drifting down long grades, the compressors discharge into a separate header, which provides an atmosphere exhaust.

The tender of this locomotive is carried on two Commonwealth cast steel trucks of the six-wheeled equalized type. The frame is a one-piece, Commonwealth steel casting. The tender is built with a stoker conveyor trough, in view of possibly changing to coal burning in the future. A pilot is placed at the rear end. With a capacity for 16,800 gal. of water and 5,800 gal. of oil, these tenders rank among the largest thus far built.

These locomotives have a height over all of 16 ft. 1 in. and a maximum width of 11 ft. 3 in. The length measured from the face of the engine front bumper to that of the tender rear bumper is 104 ft. 4 in. Further particulars concerning dimensions, weights and proportions are given in the following table:

Railroad	Great Northern
Type of locomotive	2-8-8-2
Service	Freight
Cylinders, diameter and stroke	4-28 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6¾ in.
Outside lap	1⅞ in.
Exhaust clearance	None
Lead in full gear	3/16 in.
Cut-off in full gear, per cent	65
Weights in working order:	
On drivers	532,800 lb.
On front truck	37,550 lb.
On trailing truck	24,590 lb.
Total engine	594,940 lb.
Tender	321,560 lb.
Wheel bases:	
Driving	43 ft. 7 in.
Rigid	16 ft. 6 in.
Total engine	58 ft. 2 in.
Total engine and tender	96 ft. 3½ in.
Wheels, diameter outside tires:	
Driving	outside, 63 in; center, 56 in.
Front truck	33 in.
Trailing truck	33 in.
Journals, diameter and length:	
Driving, main	12½ in. by 16 in.
Driving, others	11 in. by 14 in.
Front truck	6½ in. by 12 in.
Trailing truck	6½ in. by 12 in.
Boiler:	
Type	Belpaire
Steam pressure	210 in.
Fuel, kind	Oil
Diameter, first ring, inside	109 in.
Firebox, length and width	144 in. by 108 in.
Arch tubes, number and diameter	None
Combustion chamber length	72 in.
Tubes, number and diameter	310, 2¼ in.
Flues, number and diameter	68, 5½ in.
Length over tube sheets	24 ft.
Grate area	108 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	432 sq. ft.
Tubes and flues	6,710 sq. ft.
Total evaporative	7,142 sq. ft.
Superheating	1,896 sq. ft.
Comb. evaporative and superheating	9,038 sq. ft.
Special equipment:	
Brick arch	No
Superheater	Yes
Feedwater heater	Yes
Stoker	No
Booster	No
Tender:	
Style	Cylindrical
Water capacity	16,800 gal.
Fuel capacity, oil	5,800 gal.
General data estimated:	
Rated tractive force, 65 per cent	127,500 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	89.5
Weight on drivers ÷ tractive force	4.09
Total weight engine ÷ comb. heat. surface	65.7
Boiler proportions:	
Tractive force ÷ comb. heat. surface	14.10
Firebox heat. surface ÷ grate area	4.00
Firebox heat. surface, per cent of evap. heat. surface	6.04
Superheat. surface, per cent of evap. heat. surface	26.5

Report on grates with restricted air openings*

THE Committee on Front Ends, Grates and Ash Pans agreed to limit its report to the results of experiments on the use of restricted air openings in grates, which it had learned were in progress on two western railroads. At this time it is to give only a general statement of the purposes of these tests and some general observations on the results thus far obtained.

On one of the roads referred to, the use of grates with restricted air openings was apparently undertaken primarily because of loss of coal through the grates. This with friable coal which does not soften and coalesce on the grates may assume serious proportions. On the other road the restricted air openings were first used in locomotives burning lignite, and the practice was resorted to chiefly because of the difficulty of maintaining the fire bed in good condition with grates of the ordinary design. It appears therefore, that in both cases restricted air openings in grates have been used largely because the coal to be burned was in some respects unusual, and the committee is of the opinion that such a practice will be justified only under special conditions and that it is not likely to become widespread.

The committee believes that for the majority of railroads and for most of the coals in use the aggregate air opening in grates should continue to be made as great as the circumstances permit. With this understanding we are glad to submit the following statements concerning the practice of restricting the grate openings.

With reference to its experiments the first of the two roads referred to makes the following statement: "We have done a great deal of experimenting with different designs of table grates compared with the standard finger grates such as are ordinarily used in locomotives. We went into this experimental work on account of the waste, due to fuel falling through the finger grate in an unburned or partially burned condition."

The remainder of the statement from this road quoted by the committee may be summarized as follows: Smokebox gas analyses made with the different table grates indicated that there was still four or five per cent of free oxygen in the flue gases so that it seemed feasible to continue to decrease the size of grate openings until the effective air opening had been reduced to about 16 per cent of the total grate area, with ¾-in. circular air open-

*Abstract of report and discussion read at the seventeenth annual convention of the International Railway Fuel Association at Chicago, May 26-29.

ings, tapering to 1 1/16 in. at the bottom of the grate bar. This grate has been found to increase materially the carbon dioxide and to reduce the free oxygen. This road states that tests indicate a saving of about six per cent as compared with finger grates.

The other road referred to is the Northern Pacific. The report quotes a letter from M. A. Daly, general fuel supervisor, with respect to experience in burning Rosebud (lignite) coal mined in Montana. This coal as fired has the following analysis:

Moisture	25.66 per cent
Volatile	28.39 per cent
Fixed carbon	38.59 per cent
Ash	7.36 per cent
Heating value	8,743 B.t.u.

This coal breaks up in burning and is very difficult to keep on the grate, the strong draft lifting it and uncovering thin spots in the fire, when using grates with ¾-in. slotted openings. The grate now used has circular openings ½ in. in diameter at the top and ⅞ in. in diameter at the bottom and gives air openings from 12 to 13½ per cent of the area of the bar, and a few per cent greater air opening when measured in relation to the total grate area. It has been found that these grates also burn such coals as Pittsburgh No. 8 from Ohio and other bituminous coals satisfactorily, as well as the lignite for which they were particularly designed, and slightly increased efficiency is expected from this grate burning these coals when accurate tests are made.

The committee states that Mr. Daly is of the opinion that the success of these grates is not to be ascribed to the reduction in the aggregate air opening, but primarily to the size of the holes through the grate which reduce the force of the jets of air drawn through the grates so that they do not disturb the particles of coal on the grate when the locomotive is working.

The report is signed by Edward C. Schmidt (University of Illinois), Chairman, M. C. M. Hatch (M. K. T.), V. L. Jones (N. Y., N. H & H.), G. H. Likert (U. P.), John P. Neff (American Arch Company), C. B. Smith (B. & M.), F. C. Thayer (Southern), G. A. Young (Purdue University) and F. Zeleny (C. B. & Q).

Discussion

This report led to a lively discussion in which there was considerable disagreement as to the fundamental soundness of going to the restricted air openings described. In the experience of the Atchison, Topeka & Santa Fe with the restricted air openings described, the important points apparently are the saving through the elimination of fire dropping into the ash pan, which formerly required cleaning three or four times over a division, and the ability to maintain a light even fire. The experience on this road has led its officers to believe that sufficient air enters the firebox through the restricted grate openings to maintain satisfactory combustion. It was stated that a saving of about 6 per cent in fuel per unit of work has been observed, although this is not the result of elaborate tests.

Considerable skepticism was voiced as to the combustion efficiency obtained with the grates having the highly restricted air openings, the discussion suggesting that the restricted openings have effected their savings by stopping a heavy loss through the grates rather than by improving combustion conditions.

The evaporative capacity of locomotive boilers

Factors determining the coefficients of the proposed formula—A practical application

By Alexander P. Poperev

Part II

WE have started from an assumption that the evaporative capacity of the locomotive boiler is determined by three factors; namely, the design of the boiler, the kind of fuel and the rate of combustion. Formula (6) shows how the evaporative capacity varies with the rate of combustion, and it remains now to tie up this formula with two other factors, namely, the design of the boiler and the kind of fuel used. In other words, our present problem will be to determine the values of the coefficients in formula (6) for any given boiler and fuel.

The complexity of this problem and the difficulties connected with it can be readily appreciated, particularly if we take into account the great variety of fuels used as well as variations in the design of boilers, on the one hand, and the scarcity of suitable experimental data, which can be used for this purpose, on the other. The latter consideration presented most of the difficulties and proved to be the greatest obstacle in extending the scope of the present work.

The method, adopted by the writer for attacking this problem, was as follows: Inspection of experimental data suitable for our purpose on the evaporative performance of the locomotive boiler has shown that while they referred to a great variety of locomotive boilers, there were only two kinds of fuel used, each of fairly uniform quality. Accordingly, all the available data were segregated into two groups, according to the fuel used. This enabled us to eliminate one variable factor, the fuel, and to analyze the effect of the design of a boiler on its evaporative performance. For this purpose the values of the equivalent rate of evaporation for every locomotive in each group were plotted against corresponding rates of combustion, and the equation of a representative curve, which would agree well with the experimental data and yet satisfy formula (6) was then determined. Thus the values of the coefficients a, b and c of formula (6) were obtained for every locomotive. As the fuel in each group of data was, for all practical purposes, of the same quality, the values of the coefficients of formula (6) for each

group could be considered in accordance with our assumption as being dependent on only one variable; namely, the design of the boiler.

In order to determine the factor representing the effect of the boiler design, the obtained values of the coefficients of formula (6) were plotted against different boiler ratios. After a number of trials it was found that a smooth curve was obtained only when the values of the coefficients were plotted against the ratio,

$$R = \frac{\text{Heating surface}}{\text{Grate area}}$$

showing thereby the existence of a definite relationship between these quantities. Therefore, this ratio has been chosen as a factor representing the effect of boiler design. This should not be entirely unexpected, if we recall that the coefficients of formula (6), as it was shown above, actually represent various heat losses in the boiler expressed in terms of the equivalent rate of evaporation. From general considerations and partly from experiment we know that there exists a certain proportionality between various heat losses and the ratio R, as naturally the heat in the boiler will be utilized the better, the greater will be the amount of heating surface with respect to the grate area and vice versa.

As some of the locomotives used in the tests had a superheater, the question arose, what value of heating surface has to be taken in the determination of the ratio R. There is no fixed relation between the evaporating and superheating surfaces and as the problem concerned primarily the determination of evaporative capacity of the locomotive boiler, with all the simplification possible, it suggested itself to determine the ratio R as

$$R = \frac{\text{evaporating heating surface (excluding superheater)}}{\text{grate area}}$$

in all cases, irrespective of whether there was a superheater or not. The trials showed, that in this way the difficulty due to the presence of the superheater could be obviated, provided that the corresponding values of the equivalent rate of evaporation are calculated on the basis of heat transferred through the evaporating heating surface only; in other words, as if the boiler had no superheater at all. Accordingly, only these values of the equivalent rate of evaporation were used, and they were denoted by Z_e, in order to distinguish them from values which are usually calculated on the basis of total heat in a pound of steam.

Once a proper factor representing the effect of the design of the boiler was established, there was little difficulty in finding an empirical equation for the relationship between the values of the coefficients in formula (6) and the ratio R. In the course of determining these equations, it has been found that boilers equipped with arches have to be segregated in a separate group, as the presence of the arch produces a marked effect on the proportion of the various heat losses. Finally all available experimental data were classified into the following groups:

1—Bituminous coal.
  a—Boilers, with arch.
  b—Boilers, without arch.
2—Semibituminous coal.
  a—Boilers, with arch.
  b—Boilers, without arch.

Unfortunately, the available experimental data referring to tests with semibituminous coal and boilers without the arch were not sufficiently complete and as a result, the corresponding equations for this group were not determined. The dimensions of the boilers, the fuel used and the references from which the corresponding experimental data used for the determination of these equations were taken are listed in Table I. It is shown in this table that the ratio R varies from 33.29 up to 79.56, which covers the entire range used in practice.

TABLE I

Dimensions of boilers and kind of fuel used in experiments

	Type of locomotive and serial No.	H_e Evaporating heating surface (excluding superheater) sq. ft.	G Grate area sq. ft.	Ratio $R = \frac{H_e}{G}$	Heating value of 1 lb. of dry coal B.t. u.	% of volatile matter	References
Bituminous coal Boilers with arch	E3SD-318	1820.9	54.7	33.29	14,392	34.46	Penna. R.R. Co. Test. Dept. Bulletin No. 11
	E6S-89	2400.7	55.23	43.70	14,470	33.65	Penna. R.R. Co. Test. Dept. Bulletin No. 21
	E6S-51	2595.0	55.79	46.51	14,470	33.65	Penna. R.R. Co. Test. Dept. Bulletin No. 27
	L-1-S-1752	3676.1	70.03	52.49	14,140	31.59	Penna. R.R. Co. Test. Dept. Bulletin No. 28
	K4S-1737	3692.1	69.26	53.31	14,467	34.68	Penna. R.R. Co. Test. Dept. Bulletin No. 29
	I1S-790	3944.2	70.0	56.35	13,425	30.51	Penna. R.R. Co. Test. Dept. Bulletin No. 31
	K2SA-877	3323.1	53.72	61.86	14,530	35.08	Penna. R.R. Co. Test. Dept. Bulletin No. 18
Semi-bituminous coal Boilers with arch	Jacobs-Shuppert and radial stay boilers	2996.4	58.1	51.56	14,728	16.45	Tests of Jacobs-Shuppert Boiler - Dr. Goss.
	Consolidation No. 586	2819.2	49.43	57.03	14,913	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 15
	Vauclain 4 cyl. cpd. No. 535	2902.1	48.36	60.01	14,967	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 18
	Cole 4 cyl. cpd. No. 3000	3000.0	49.9	60.12	14,989	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 20
	L.S. & M.S. Ry. No. 734	2541.22	33.76	75.27	14,907	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 14
	De Glehn cpd. No. 2612	2565.5	33.39	79.56	14,916	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 17
Semi-bituminous coal Boilers without arch	E-2A No. 5266	2319.3	55.5	41.79	15,143	16.13	Penna. R.R. Co. Test. Dept. Bulletin No. 5
	Simple Consolid. No. 1499	2482.3	49.21	50.44	14,141	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 13
	Hannover cpd. No. 628	1753.2	29.06	50.56	14,998	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 19
	Jacobs-Shuppert and radial stay boilers	2996.4	58.10	51.56	14,805	16.45	Tests of Jacobs-Shuppert Boiler - Dr. Goss.
	Schenectady No. 3	943.0	17.0	55.47	14,347	15.23	Superheated steam in Locomotive Service - Dr. Goss.
	Tand. cpd. Santa Fe No. 929	4306.13	58.41	73.73	15,007	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 16

The results obtained—Values of the coefficients of formula (6) and their equations

The physical significance of the coefficient a is, as it has been shown, a heat loss due to radiation, leaks, etc.,

expressed in terms of the equivalent rate of evaporation. This kind of loss is naturally totally independent of the kind of fuel used and being calculated per unit of heating surface of a boiler, may be considered without any serious error as constant for all designs of locomotive boilers. The actual values of coefficient a obtained for different locomotives varied but little from each other and an average value of 0.4 was accepted as a representative value of this coefficient for any boiler or fuel. It is interesting to note, that according to Dr. Goss's[1] experiments with stationary locomotive boilers, the total heat loss at the beginning of cooling off was equal to 273,000 B.t.u. per hour, which in terms of equivalent rate of evaporation amounted to 0.231 lb. per sq. ft. per hour. During motion the average heat loss amounted to 6,000 B.t.u. per minute or 0.305 lb. per sq. ft. per hour in terms of equivalent evaporation. In other words, the value obtained for the coefficient a comes very near to the experimental data.

Semi-bituminous coal for boilers having an arch:

$$(8) \quad \ldots\ldots\ldots\

Z_e = the equivalent rate of evaporation, from and at 212 deg. F., of wet steam in lb. per sq. ft. of evaporative heating surface (excluding the superheater) per hour.

Y = the rate of combustion in pounds of dry coal per sq. ft. of grate area, per hour.

R = the ratio of evaporating heating surface (excluding the superheater) to grate area.

r = the heat of vaporization from and at 212 deg. F.

K = the heating value of 1 lb. of dry fuel in B.t.u.

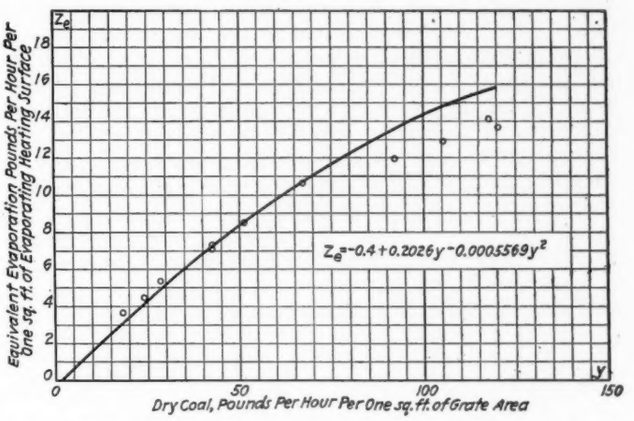
e = 2.7183, the base of the natural logarithms.

One must not, of course, consider the above expressions as exact or final; the experimental data on which they are based were none too numerous and like every empirical equation, they are subject to corrections with the further accumulation of experimental data, particularly in the values of the coefficients. However, in nearly all of the nineteen locomotives which were analyzed and enumerated in Table I, they come to a rather surprising close agreement with experimental data. Lack of space prevents the showing of plots for every locomotive. Those, which are shown here, as well as in Part I of this article are fairly representative for the large majority of the plots. Only in very few cases was there a disagreement which did not exceed 15 per cent between the values determined by the above formulas, values obtained from experiment. The disagreement manifested itself however mostly at rather high rates of combustion. Considering this we must have in view a few cases, taken from the Pennsylvania tests, in which attention has been called to the fact, that there was noticed at the higher rates of combustion an insufficient air supply, and the evaporation was below normal; besides, the experimental data per se are hardly more accurate, at the best, than within 10 or 15 per cent.

It is believed, however, that even with this inaccuracy the suggested expressions will be found useful in ordinary practice, as they permit one to estimate the probable evaporative capacity of the locomotive boiler with greater accuracy than with any of the other existing formulas. No doubt, with the accumulation of experimental data it will be found possible to increase the accuracy still more, particularly when experiments with a greater variety of fuels would permit one more accurately to account for the influence of this factor in the formulas. The experiments must be complete to obtain definite results.

Diagram for the evaporative capacity of the locomotive boiler

Despite every attempt to simplify the problem as much as possible, the resulting expressions obtained are too complicated to be conveniently used in practice. However, a diagram, embodying these expressions can be easily constructed, by means of which all necessary calculations can be performed in the most simple manner.


Ze
Equivalent Evaporation Pounds Per Hour Per One sq. ft. of Evaporating Heating Surface
Ze=-0.4+0.2026y-0.0005569y²
y
Dry Coal, Pounds Per Hour Per One sq. ft. of Grate Area

Curve showing the evaporative capacity of the Vauclain four-cylinder compound No. 535—Boiler dimensions and kind of fuel used is shown in Table I

The diagram, shown in Fig. 4, consists of four quadrants. In the upper right quadrant the values of the coefficient $b = \frac{K}{Rr} - n$ for different values of K are plotted as ordinates against corresponding values of R as abscissae. Now for any given value of y the quantity by, which represents the second term in formula (6), can be represented by a straight line, when referred to

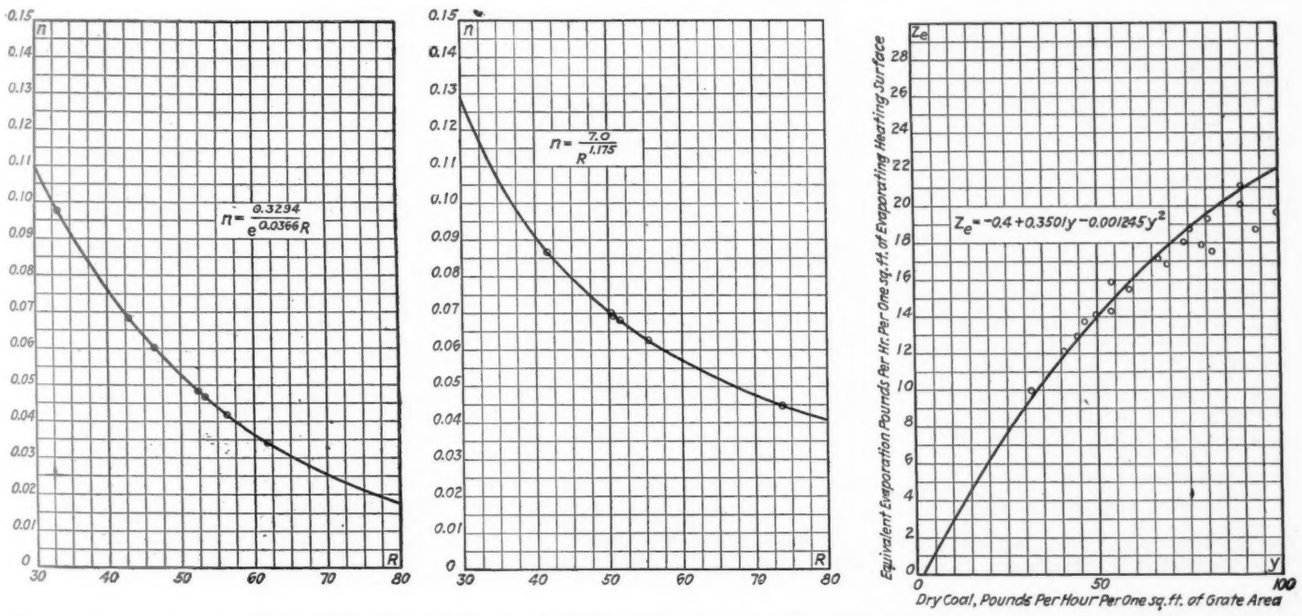
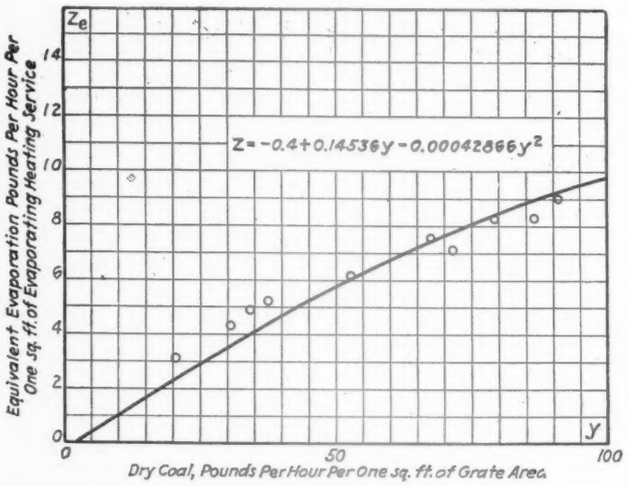

n
n= 0.3294 / e^0.0366R
R
n= 7.0 / R^1.175
Ze
Ze=-0.4+0.3501y-0.001245y²
Equivalent Evaporation Pounds Per Hr. Per One sq. ft. of Evaporating Heating Surface
y
Dry Coal, Pounds Per Hour Per One sq. ft. of Grate Area

Fig. 2—First two charts show values of coefficient n: Left—for bituminous coal and boilers having an arch; Center—for semi-bituminous coal and boilers without an arch. Right—Curve showing evaporative capacity of Pennsylvania locomotive No. 318, class E 3S D

*See the *Railway Mechanical Engineer* for August, 1925, page 491.

the co-ordinate axes O-B and O-P. Such lines are plotted in the upper left quadrant for different values of y, from $y = 10$ lb. per sq. ft. up to $y = 150$ lb. per sq. ft., and the result is read off on the axis O-P. In the lower right quadrant are plotted as ordinates the values of the coefficient c of the formula (6) against corresponding values of R as abscissae. Again, for every given value of y, the expression $a + cy^2$ being referred to the co-ordinate axes O-C and O-Q can be represented by a straight line. These lines are drawn in the lower left quadrant, likewise for different values of y, from $y = 10$ lb. per sq. ft. up to $y = 150$ lb. per sq. ft., and the result is read off on the axis O-Q, which, for convenience, has a double scale compared with that of the axis O-P. Thus, the construction of the diagram does not present any difficulties, particularly if we remember that for the construction of every straight line in both the left hand quadrants, it is necessary to calculate only two values of the corresponding expressions by and $-(a + cy^2)$.

The method of using the diagram will be clear from the following example. Suppose we want to find the value of Z_e for $y = 100$ lb. per sq. ft. for a boiler having an arch and having the ratio $R = \frac{H_e}{G} = \frac{3676.1}{70.03} = 52.49$, the fuel being bituminous coal having a heating value of 14,140 B.t.u. per pound of dry coal. On the axis O-R we read of the value $R = 52.49$ and from this point follow up vertically to the intersecting point q with a curve in the upper quadrant, corresponding to the heating value for the coal of 14,140 B.t.u. From this point we proceed parallel to the axis of abscissae until we intersect the straight line in the upper left hand quadrant corresponding to $y = 100$ lb. per sq. ft. at the point s. On the axis O-P we read of the value of by equal to, say, 23.0.



Curve showing the evaporative capacity of a cross-compound consolidation locomotive, shown in Table I as No. 585

Starting again from the point t on the axis O-R and proceeding this time downward, parallel to the axis of ordinates, up to the intersection point u on the curve C, and from it horizontally up to the intersection (point v) with the straight line in the lower left hand quadrant corresponding to $y = 100$ lb. per sq. ft., we read on the axis O-Q a value, say 7.2. By subtracting it from the value found before we obtain a value for Z_e corresponding to $y = 100$ lb. per sq. ft.

$$Z_e = 23.0 - 7.2 = 15.8 \text{ lb. per sq. ft. per hour.}$$

Obviously, the same simple procedure applies to finding the value Z_e for any value of y.

Other relationships derived from formula (6)

While the relationship between the rate of evaporation and the rate of combustion represents a basic relationship which fully characterizes the performance of a boiler, it is desirable sometimes to know how other factors—for instance, the efficiency of the boiler, or rate of evaporation per pound of fuel—vary with the rate of combustion. It can be easily shown that once the relationship between the rate of evaporation and the rate of combustion is established for any given conditions, all these relationships can be very easily derived from the formula (6). As an example we shall consider here the derivation of the formulas for the relationship between the rate of combustion and the efficiency of the boiler, as well as the rate of evaporation per pound of fuel.

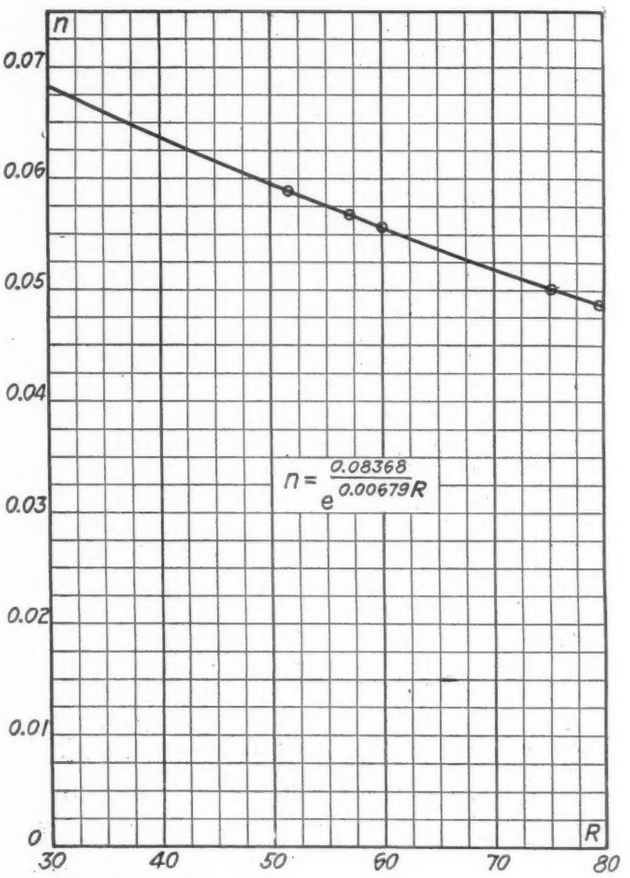


Fig. 3—Curve showing the values of the coefficient n for semi-bituminous coal and boilers having an arch

From the general definition of the efficiency of the boiler

$$\text{Eff.} = \frac{\text{Heat utilized}}{\text{Heat consumed}}$$

and using the same notations for the heating surface, grate area, rates of evaporation and combustion as above, we have

$$\text{Eff.} = \frac{HZr}{KGy} \qquad (16)$$

substituting in equation (16) the expression for Z according to formula (6) we have

$$\text{Eff.} = \frac{Hr}{KG}\left(\frac{-a + by - cy^2}{y}\right)$$

$$= \frac{Hr}{KG}\left(-\frac{a}{y} + b - cy\right)$$

For any given boiler and fuel the factor $\frac{Hr}{KG} = \frac{Rr}{K}$ is constant and therefore we can write

(17) ..... $\text{Eff.} = -\frac{p}{y} + q - sy$

where $p = \frac{Hr}{KG}a$; $q = \frac{Hr}{KG}b$, and $s = \frac{Hr}{KG}c$

are constants for a given boiler and fuel.

(18) ..... $y_{\text{max. eff.}} = \sqrt{\frac{p}{s}}$

Substituting this in (17) we obtain the maximum value of the efficiency of the boiler as

(19) ..... $\text{Eff.}_{\text{max.}} = q - 2\sqrt{ps}$

From formula (6) it is also very easy to derive, in the same way as above, an expression for the relationship between the rate of evaporation per pound of fuel and the rate of combustion. The rate of evaporation per pound of fuel evidently can be expressed in the following way

(20) ..... $f = \frac{ZH}{Gy} = \frac{ZR}{y}$

Substituting the expression for Z from formula (6), we have

$$f = \frac{ZR}{y} = \frac{(-a + by - cy^2)R}{y}$$

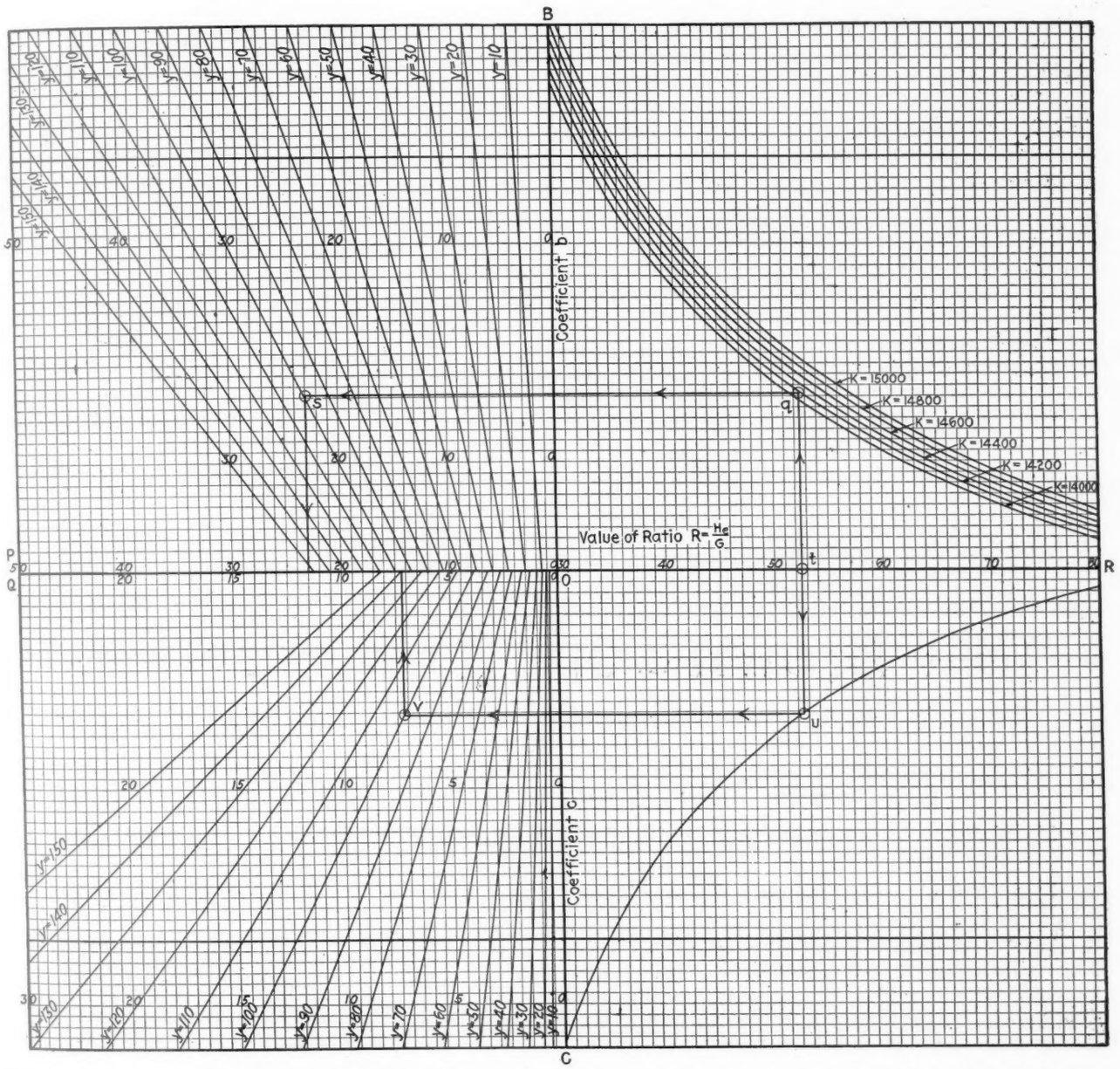


Fig. 4—Diagram for use in calculating the evaporative capacity of locomotive boilers having an arch and fired with bituminous coal

The formula (17) represents the expression of the relationship between the efficiency of a boiler and the rate of combustion and is the equation of a hyperbola. It permits us to determine the maximum value of the efficiency of the boiler, as well as the rate of combustion at which it occurs.

By differentiating formula (17) we obtain the value of the rate of combustion corresponding to a maximum value of the efficiency of the boiler

and as $R = \frac{H}{G}$ is constant for a given boiler and fuel, we have

$$f = \frac{-aR}{y} + bR - cRy =$$

$$(21) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots = -\frac{m}{y} + t - vy$$

where

$$m = aR;\ t = bR, \text{ and } v = cR$$

are constants for a given boiler and fuel.

The maximum value of the rate of evaporation per pound of fuel will be found in a similar manner as follows:

$$(22) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots f_{max.} = t - 2\sqrt{mv}$$

and the corresponding rate of combustion

$$(23) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots y \text{ f equals max.} = \sqrt{\frac{m}{u}}$$

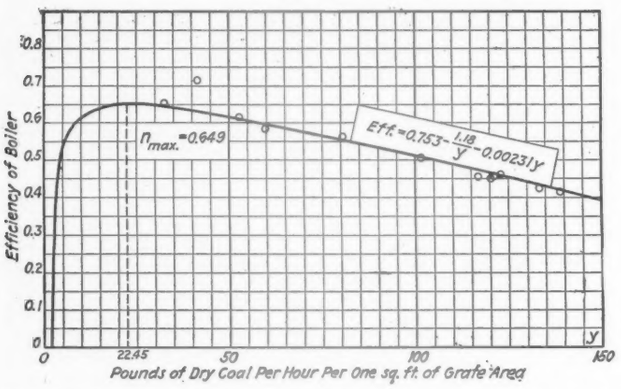


Fig. 5—Curve showing the relationship between the boiler efficiency and rate of combustion—Data taken from Pennsylvania R. R. Tests

Figs. 5 and 6 illustrate the application of the above expressions to experimental data. As it can be seen from the plots, the maximum of both the efficiency and the rate of evaporation per pound of fuel occurs at rather low rates of combustion, which are not only outside of the usual service range, but also usually outside of the experimental range. To this fact can be attributed many wrong conclusions in regard to the nature of these relationship between the rate of evaporation and the rate of combustion. On the contrary, by applying the same analysis to expressions (17) and (21), we fail to find any similar contradictions, which fact can be considered as an additional proof that the basic expression (6), from which these formulas are derived, is correct.

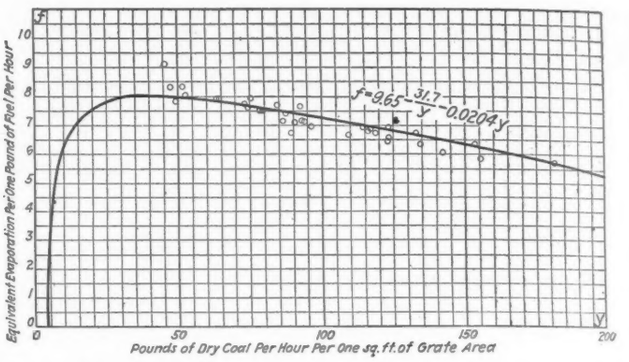


Fig. 6—Curve showing the relationship between the rate of evaporation per pound of fuel and the rate of combustion—Data taken from Dr. Goss' tests

"Bill Brown" or "Top Sergeant" —which?

Our readers, judging from the letters to the editor, are taking a keen interest in this controversy

NATURALLY there are a great many differences of opinion as to the duties and responsibilities of foremen and supervisory officers. The first prize article in the *Railway Mechanical Engineer* competition on the opportunities and responsibilities of the foreman, written by "Bill Brown" was published in the June *Railway Mechanical Engineer;* three communications concerning it appeared in the August number, page 492. Two of the writers backed up "Bill Brown" and enlarged upon some of his suggestions. "Top Sergeant," however, drastically criticized him.

Shortly after the distribution of the August number we began to receive communications, the first three more or less unreservedly backing up "Bill Brown" and taking issue with "Top Sergeant." The fact that these letters came from such widely scattered sections as Michigan, Texas and Ohio made it look as if there was nothing to the controversy and that "Bill Brown" would walk away with all the honors. Later mails, however, brought letters of a very different sort, either strongly supporting the position of "Top Sergeant" or criticizing "Bill Brown." A selection from these communications follows. Which side do you agree with?

"Top Sergeant" a supreme egotist

GALVESTON, TEX.

TO THE EDITOR:

The letter on page 492 of your August issue may perhaps be somewhat of a surprise to those higher railway officers who may chance to read it.

It is not often that a person of the calibre of "Top Sergeant" has either the intelligence or the audacity to set down his candid opinions in black and white. Unfortunately, however, his kind are only too numerous in minor supervisory positions in the railway service, and his remarks should be earnestly recommended to the careful perusal and consideration of those executives who are constantly bewailing the lack of "loyalty and co-operation" on the part of their employees.

"Top Sergeant" betrays his supreme egotism in his

attitude toward the railway trade journals, although he seems able to spare sufficient of his valuable time to keep posted on the work of his favorite cartoonists. In view of his extraordinary complete knowledge of railway mechanical engineering, one wonders why he chooses to remain in a subordinate position rather than engage in more remunerative consulting practice where he will have sufficient time to study and read literature that will tend to broaden his mind and dispel his pessimistic views of his fellowmen.

Were it not for the fact that he is deadly earnest, "Top Sergeant's" letter, which is but the pathetic effusion of a small and reactionary mind, would deserve a position on the humorous page.

An ex-apprentice boy,
ALFRED M. HALLINGTON.

The foreman—a superman?

RAILROAD SHOP.

TO THE EDITOR:

"Bill Brown," the author of the prize article on "The Foreman and His Responsibility" is surely an optimist and has kidded himself into looking at the bright side of the picture. Your editorial in the June number indicated that he was a successful shop superintendent. I wonder whether his position is not such that he is too far above the department foremen and does not understand all of the difficulties that they are up against in these days.

I have been a foreman in the machine shop for many years. Twenty years ago we did not have any of these high-fangled notions about dealing with the men and we managed to get along pretty well. I have 40 men under me and it keeps me mighty busy seeing that they are on the job and that the finished material gets to the erecting side in time not to delay the locomotives. My shoe bill is a heavy one, because I have to cover a lot of ground every day and there is little time or opportunity for going into the fine points of dealing with the workers. The grievance committee is going to keep busy anyway and it is a waste of time for me to worry much about the boys, whose leaders are working overtime to look after their interests. I have all I can do to keep things moving.

Another thing—it would appear that some sort of a superman is required to fill the foreman's position. You want a man to be a master craftsman, to carry all the responsibilities of getting output and dealing with other departments, and on top of this to be an expert on management—a regular operating vice-president. And what do we get out of it? A lot of responsibility and worry and a little more money than an ordinary mechanic. We have no union looking after our welfare and interests and we are even "docked" for being sick or taking a vacation.

You will probably not dare to publish this, but why side-step the real issue? If you are going to try to start something, why not come clean and lay all the cards on the table, face up? Please consider as confidential my real name and location.

"BILL BLACK."

"Top Sergeant" cold-blooded

MICHIGAN.

TO THE EDITOR:

The commentary of the "Top Sergeant" in the August *Railway Mechanical Engineer* discloses that there still exists a railroad supervisor lacking in that primary attribute to the successful handling of men and problems—"latitude and thought."

We are no longer in the era of "constituted authority" which was the law of the masters, but in a community of interest where every man feels a sense of responsibility to both the company and his fellowmen. The masters of finance and industry have themselves become reconciled to this inevitable fact. Public opinion is its pathfinder; it is founded on the teaching of Christ—justice, sympathy and kindness. Discipline, however, need not be compromised. This we can administer without entailing sacrifice. These sentiments appeal to decency and the hearts of men and make for loyalty and happiness, and the germ when fertilized will permeate the atmosphere, infecting those in all departments and everyone will thereby profit.

The inference of "Top Sergeant" that the army countenances the practice he advocates is folly. As an officer of the Engineers, U. S. A., where discipline is a primary factor, I never witnessed such cold blooded treatment of men. If a "Top Kick" of mine had attempted to exert his will by coercion, I would have immediately "busted" him and put him in the ranks.

A measure of a man's ability to forge ahead is directly proportioned to his willingness and ability to study, accept and assimilate new laws and ideas. It isn't so much what he knows, as it is how he came to know what he knows. In the case of the "Top Kick" he accepts no new ideas from any source—management, salesmen, mankind, or otherwise. How supreme and secure he must feel in his limited domain. It is inconceivable to me that a man could be inspired to take such an attitude toward his fellowmen. It tinges with the deliberations of one soured on labor, management, self and mankind generally.

CAPTAIN BLOOD.

Backs up "Top Sergeant"

NEW JERSEY.

TO THE EDITOR:

I am very much interested in the discussion which "Bill Brown's" article has stirred up and wish to take this occasion to say my hat is off to the "Top Sergeant."

Here in my opinion as a railroad shop foreman who *knows* how to handle his men and get a real day's work out of every one of them. I will bet the cigars any time that "Top Sergeant" can take "Bill Brown's" gang and not only get greater outputs but also make such a favorable impression upon the men that if they were given their choice they would prefer to stay in "Top Sergeant's" gang.

No other industry or vocation has ever produced a finer body of men than our American railroads, but up to the present time of writing not one department has yet reached that mollycoddle stage where the men expect to be petted and coaxed into doing their day's work. The supervisor who has the courage to say: "By G—! I want it done this way and right away," never fails to get the cooperation which produces the desired output.

I fully agree with "Top Sergeant" that there is altogether too much of this brotherly love stuff being spilled. It may work out all right in fiction or the movies but in actual practice you will find it a pretty tough job to keep down the cost of production after you once start singing sentimental lullabys to your men. I also believe as the "Top Sergeant" that "Bill Brown" has missed his vocation and should be addressing audiences from the pulpit and not from a work bench on the shop floor.

Mr. Editor, if you really wish to learn something about how much sentiment there is in the human nature that a shop foreman has to contend with, just make arrangements with some railroad to temporarily masquerade yourself in this capacity and address your prospective gang in the manner "Bill Brown" advocates. I warn

you right now to be mentally prepared for the biggest razzing you ever got in your life.

It does not require much of an imagination to picture the delightful atmosphere of congeniality that must prevail in "Bill Brown's" department—what a wonderful improvement over the Garden of Eden it must be—where new workmen are cordially invited to take off their hats, get acquainted and are informed to be very careful about straining themselves for a few days; where a royal welcome awaits every so-called sales engineer who has a mythical story of wonderful tool performances to relate —where operators are expected to stop their machines while retrieving some valuable nut or bolt and where the foreman has time to make a scientific study of the men's point of view and then makes allowances for the cussedness found in human nature.

It may be that the railroads are now looking for the kind of shop foreman "Bill Brown" recommends but I personally will doubt it until the day arrives when I am paid to visit other shops for observant purposes—until I have once been allowed to select a machine tool which I know my department badly needs and until there is no longer need for a foreman to scour the scrap yard for a couple of apprentice boys who prefer to consume their "Lucky Strikes" on the company's time.

F. O. REMAN.

"Objects to 'Top Sergeant's" arguments

LORAIN, Ohio.

TO THE EDITOR:

"Bill Brown" certainly did start something as evidenced by "Top Sergeant's" comments in the August *Railway Mechanical Engineer,* page 493. It is good to get the viewpoint of men, and without quarreling with their ideas we may at least try to prove or contest the soundness or practicability of their methods in dealing with employees or other affairs in their shops.

"Top Sergeant," I have read carefully your comments. You may be a top sergeant for all I know or care, but from a mere shopman's point of view, "granted that your opinions express your methods," you belong to a class of supervisors which is rapidly disappearing. Adopting the attitude of, "I am Monarch of all I survey; there is none my power to dispute," may be to you the essence of glory, but to the man in the shop it is ridiculous.

Your first contention, Why should a shopman play in the town band? Well, why don't you deny him the right to be a church member or an attendant at Sunday school? There would be just as much sense to it.

Second, calling his men together for a talk. That one item, proven by experience, has done more for production and general welfare than all the "drivers" in the world got out of their men.

Third, reading the railway journals. Why, my dear old top, your very words show how necessary it is that you get those bundles of journals out of their covers. Read, learn and digest!

Fourth, new employees. Did you ever stop to consider that no matter how good and experienced the new man may be, it takes a little time for him to accustom himself to his new surroundings, and the best mechanic that ever lived would need more than twenty minutes to prove his ability to a "hard-boiled" guy?

Fifth, new tools. Sure, you are not reading the journals and their advertisements, so you can't very well know, but lots of us know that the shop tools now being sold are far in advance of some sold two years ago.

Sixth, sales engineers. Have not had any experience with them, so cannot express any opinion.

Seventh, conservation of material. For this we agree as one of the best ideas put forward by the railroads, but, "Serge," if "Bill" dropped the only one inch nut he had, would you insist that he get an order for another instead of picking that one up?

Eighth, relationship to foremen of other departments. No, it is not Sunday school stuff, but good business sense. You can have competition between the different departments without bucking one another.

Ninth, attitude towards apprentices. At the recent centennial celebration of Akron, Ohio, among the exhibits were working models of both steam and electrical driven locomotives, complete to the minutest detail, the building of which, we were told, was done entirely by the apprentices of different railroads. Such work could not have been done by apprentices that were treated "rough" as you advocate. The August *Railway Mechanical Engineer,* page 511, contains a report of work done by apprentices of the Kansas City Southern, also showing their photographs. Do they look like a lot of dumb-driven cattle, as evidently you would have them?

"Top Sergeant," your comments are not in line with present-day tendencies, which are far superior to those of days gone by. Again, let me ask you to read your journals; come out from behind the clouds and into the light of day.

JOSEPH SMITH,
Boilermaker, Baltimore & Ohio.

Slave-drivers not wanted

BRISTOL, Va.

TO THE EDITOR:

"Top Sergeant's" viewpoint and treatment of the men under him are the principal causes of most of this dissatisfaction and unrest among workingmen today.

No man in authority who is clothed in his right mind wants a large labor turnover. Yet how can a man such as "Top Sergeant" expect any man to want to work for him? Everyone, with the exception of a few "Top Sergeants," has agreed that the contented workman is the best workman. A man cannot be contented working for a sour, fault-finding, get-to-hell foreman.

A foreman of the "Top Sergeant" variety is out of place in the railroad shop of today. The few that are left should be relegated to the corn and cotton fields, and to the construction camps, there to end their days viewing the business end of a mule in their daily toil, where they can vent their spleen to their heart's content. Their mouthings will be lost on the mule and will harm no one but themselves.

Although I am not in the mechanical department, I am glad that I work for a railroad where the management believes in treating the employees as human beings.

BUCK PRIVATE.

H. J. FORSTER, secretary of the American Railway Association, announces that the modifications of car service Rule 11, set forth in his circular No. 2524 have been adopted by the association, as shown by the letter ballot which he recently recorded. This rule provides for marking freight cars with both nominal capacity and load limit, and for showing the cubical capacity with the inside dimensions.

BULLETIN No. 9 has been issued by the Railway & Locomotive Historical Society, 6 Orkney Road, Brookline, Mass. The principal article is a 12-page sketch of the history of the Portland Company, Portland, Maine, as a former prominent builder of locomotives. This company, still flourishing in other lines, has built no locomotives since 1907. In 1852 it built the first locomotives for the Panama Railroad, and in 1882-83 built 100 for the Northern Pacific. Another bit of history contained in this pamphlet says that the New York & Erie, in 1856, employed 500 men, owned 203 locomotives and had a telegraph with 60 telegraph agents "so that any occurrence on the road could be instantly made known to the officers."

S. P. and U. P. acquire three-cylinder 4-10-2 locomotives

Tractive force of S. P. with booster is **95,700** *lb. and that of U. P. with no booster is* **78,000** *lb.*

RECENTLY the American Locomotive Company, New York, delivered to the Southern Pacific 16 three-cylinder locomotives of the 4-10-2 type and one of the same type to the Union Pacific. These locomotives have a new wheel arrangement which is a development from the 2-10-2 type in which the two-wheel leading truck has been replaced by a four-wheel truck.

The Southern Pacific locomotives, which will be known on that road as the Southern Pacific type, are used for hauling passenger and freight trains over the Sierra Nevada mountains where the maximum grade is 2.2 per cent. The Union Pacific locomotive, which will be known as the Union Pacific Overland type, has been operated for some time on the western end of the road and its performance is also to be carefully observed on all the other lines of the system: namely, the Los Angeles & Salt Lake, Oregon Short Line and the Oregon-Washington Railroad & Navigation Company.

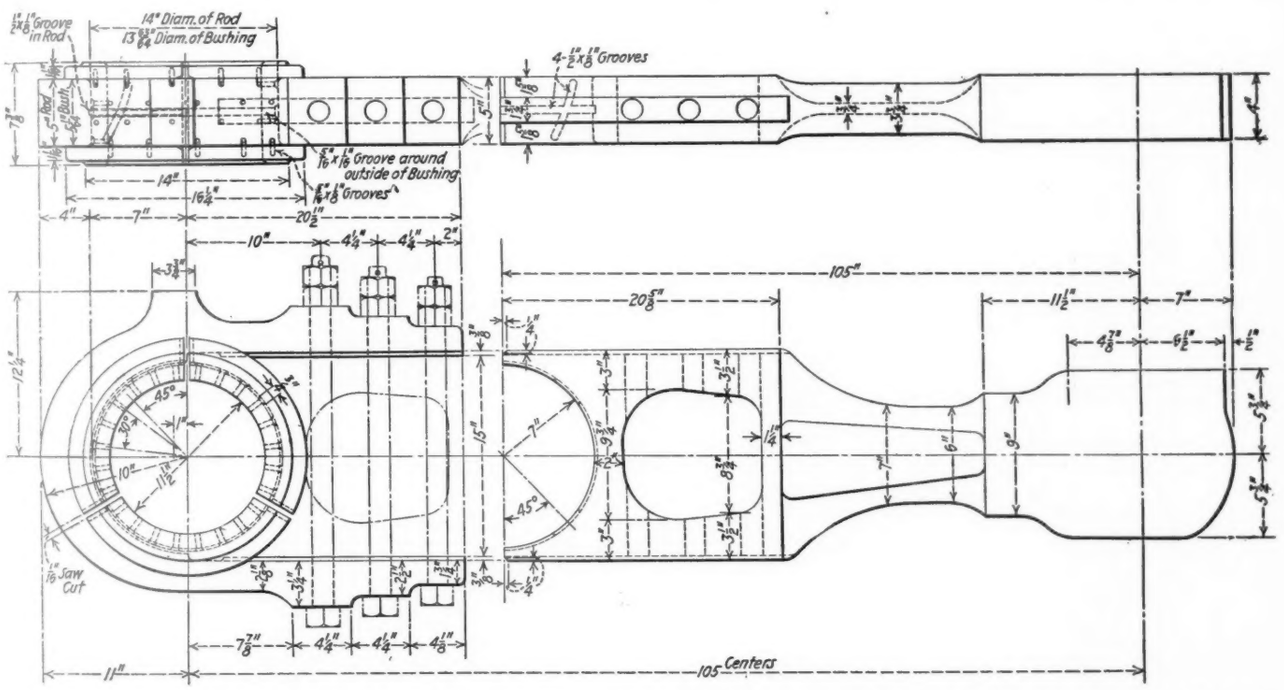
The Southern Pacific locomotives weigh 442,000 lb., of which 316,000 lb. is on the drivers, 65,500 lb. on the front truck and 60,500 lb. on the rear truck. They carry 225 lb. boiler pressure; the cylinders are 25 in. in diameter, the strokes being 32 in. outside and 28 in. inside, and the driving wheels are 63½ in. in diameter. With a maximum cut-off of 70 per cent, they develop a tractive force of 83,500 lb., which is increased to 95,700 lb. by the trailer booster. These are the most powerful non-articulated locomotives yet built. They burn oil and are equipped with Worthington feedwater heaters.

The Union Pacific locomotive weighs 405,000 lb., of which 288,500 lb. is on the drivers, 60,000 lb. on the front truck and 56,500 lb. on the rear truck. It carries 210 lb. boiler pressure and, like the Southern Pacific locomotives, the cylinders are 25 in. in diameter. The stroke of the outside cylinders, however, is 30 in., while that of the inside cylinder is the same as on the Southern Pacific locomotives. The driving wheels are 63 in. in diameter. With a maximum cut-off of 85 per cent a tractive force of 78,000 lb. is developed. Semi-bituminous coal is used as a fuel and is fired with an Elvin stoker.

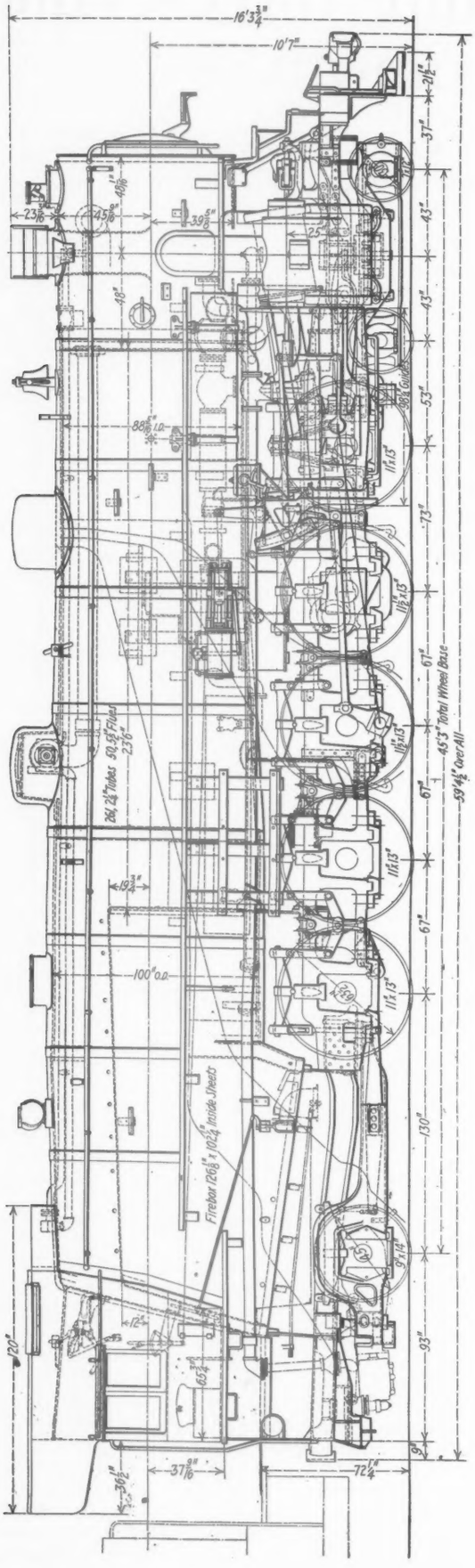
Boiler equipment

The boilers of these locomotives do not differ materially from the usual type of design. The overall length of the Union Pacific boiler is 49 ft. 7-7/16 in., while that of the Southern Pacific is 49 ft. 1¾ in. The other general dimensions of the Union Pacific boiler are slightly smaller than those of the Southern Pacific. The boilers of the locomotives of both companies are equipped with 50-unit Type superheaters.

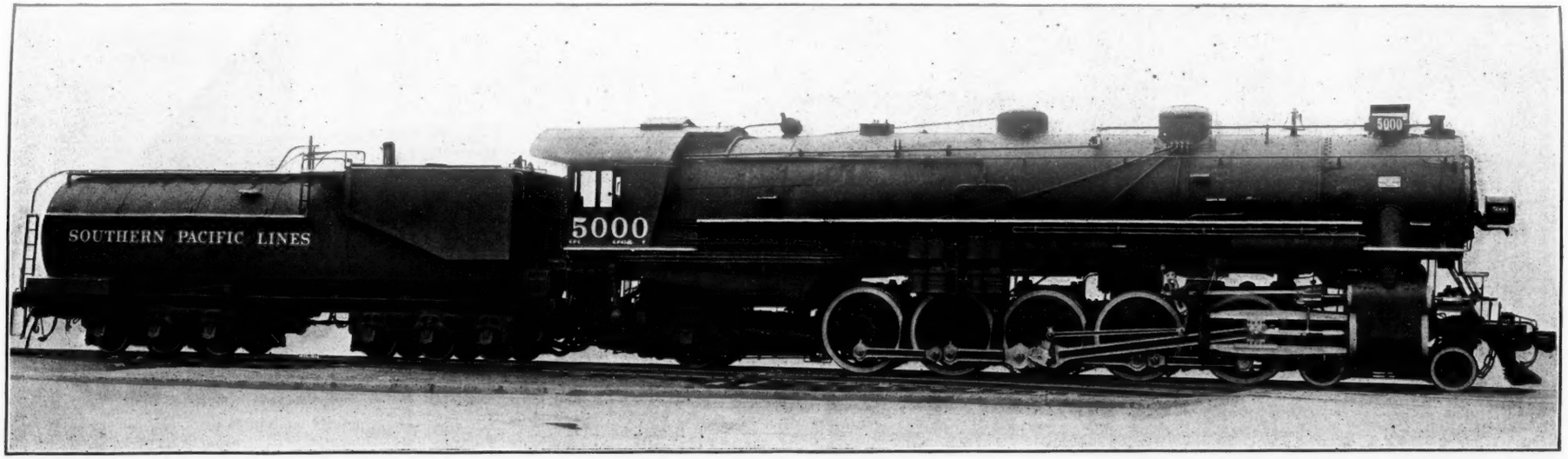
In the Southern Pacific locomotives the Bradford front end throttle is used which is located in the superheater smokebox between the superheater and the main steam cylinders. This provides superheated steam for operating auxiliaries, such as the air compressors, feedwater heater, headlight generator, oil atomizer and the blower. Two Westinghouse cross-compound air compressors are mounted on the right side of the locomotive beneath the



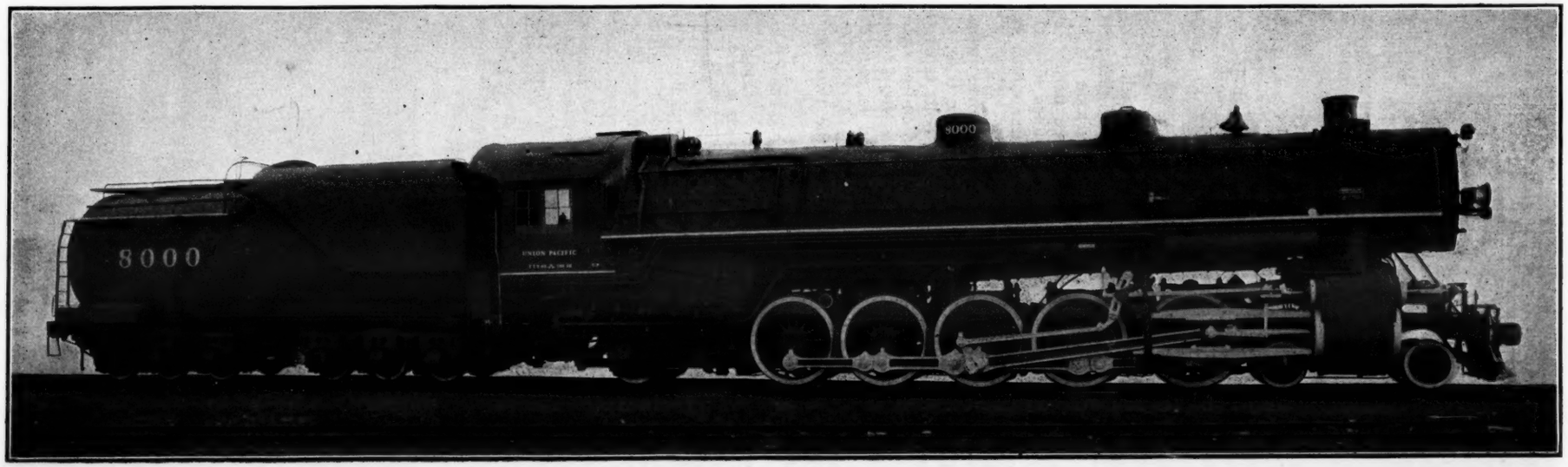
Middle main driving rod designed with an adjustable front end with rotor bushings and a strap back end with floating bushings



Elevation and cross sections of the 4-10-2 Type Southern Pacific locomotive



Southern Pacific, three cylinder, 4-10-2 Type locomotive which develops a tractive force of 83,500 lb. at 70 per cent cut off and 95,700 lb. with the booster, making it a powerful non-articulated locomotive



Union Pacific, three cylinder 4-10-2 type locomotive which develops a tractive force of 78,000 lb. at 85 per cent cut-off and 210 lb. boiler pressure—Total weight of locomotive, 405,000 lb. and with tender 647,500 lb.

running board, while on the Union Pacific the same size New York air compressors are mounted on the left side of the locomotive.

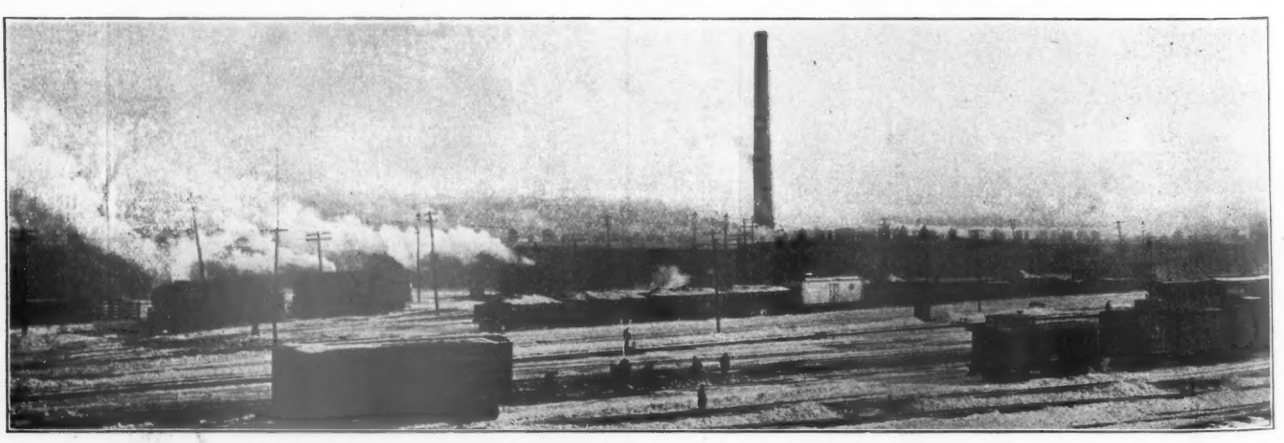
Running gear

Steam distribution is controlled by the usual outside valve gear. The valve stems of the two outside steam chests are extended and are connected just ahead of the chests by the same arrangement of levers used to operate the valve for the third cylinder on the three-cylinder locomotives previously built by the American Locomotive Company. The valve chambers of these locomotives are bushed to take 11-in. piston valves. They are operated by the Walschaert gear, controlled by the Alco Type E power reverse gear on the Southern Pacific engines and by the Franklin precision gear on the Union Pacific locomotive.

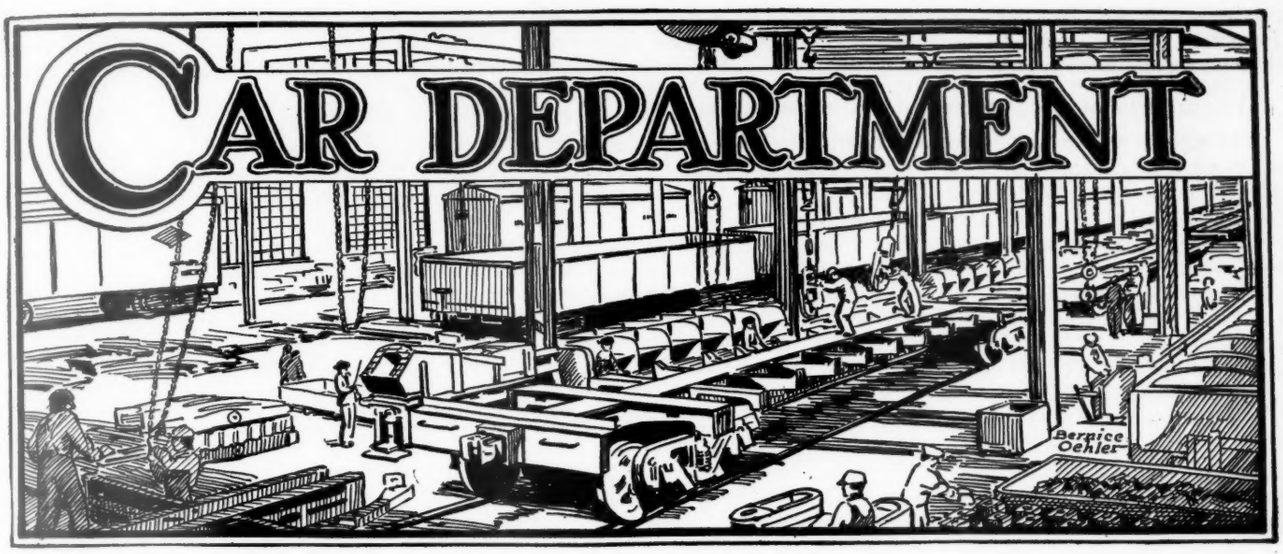
The middle main rod of a three-cylinder locomotive is rather difficult to get at for repairs. In order to reduce the wear of the bushings to a minimum, these rods are provided with an adjustable front end with rotor bushings and a strap back end with floating bushings. The back bushing, which fits over the crank axle of the second pair of drivers, is divided into three parts. It contains four rows of 5/16-in. holes, 12 holes in each row, alternately spaced. The holes are countersunk ¾ in. on the outside. This arrangement provides for equal distribution of the lubricant as the bushing moves in its fit around the pin. The strap dovetails on the body of the rod and is held in place by three 1¾-in. bolts tapered 1/16 in. in 12 in. Two nuts are put on the end of each bolt which are prevented from coming off by No. 4 taper pins, 2½ in. long. The weight of the rod is reduced by an opening through back end of the rod.

The principal dimensions and data for the two locomotives are shown in the following table:

Railroad	Union Pacific	Southern Pacific
Type of locomotive	4-10-2	4-10-2
Service	Passenger	Passenger
Cylinders, diameter and stroke	2—25 in. by 30 in. 1—25 in. by 28 in.	2—25 in. by 32 in. 1—25 in. by 28 in.
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size	11 in.	11 in.
Maximum travel	6¼ in.	6 in.
Outside lap	1⅛ in.	1½ in.
Exhaust clearance	None	1/16 in.
Lead in full gear	3/16 in.	3/16 in.
Cut-off in full gear, per cent	85	70
Weights in working order:		
On drivers	288,500 lb.	316,000 lb.
On front truck	60,000 lb.	65,500 lb.
On trailing truck	56,500 lb.	60,500 lb.
Total engine	405,000 lb.	442,000 lb.
Tender	242,500 lb.	244,000 lb.
Wheel bases:	Union Pacific	Southern Pacific
Driving	22 ft. 6 in.	22 ft. 10 in.
Rigid	16 ft. 6 in.	16 ft. 9 in.
Total engine	44 ft. 1 in.	45 ft. 3 in.
Total engine and tender	82 ft. 5 in.	87 ft. 3¼ in.
Wheels, diameter outside tires:		
Driving	63 in.	63½ in.
Front truck	30 in.	30 in.
Trailing truck	45 in.	45½ in.
Journals, diameter and length:	and sec. 11 in. by	and second 11½ in by
Driving, main	12 in.	13 in.
Driving, others	10 in. by 12 in.	11 in. by 13 in.
Front truck	6½ in. by 12 in.	7 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Inverted wagon top	Inverted wagon top
Steam pressure	210 lb.	225 lb.
Fuel, kind	Semi-bituminous	Oil
Diameter, first ring inside	86¼ in.	88 5/16 in.
Firebox, length and width	126 in. by 96 in.	126⅛ in. by 102¼ in.
Height mud ring to crown sheet, back	75⅛ in.	70 in.
Height mud ring to crown sheet, front	87⅛ in.	88 in.
Arch tubes, number	4	None
Combustion chamber length	60¼ in.	74in.
Tubes, number and diameter	250—2¼ in.	261—2¼ in.
Flues, number and diameter	50—5½ in.	50—5½ in.
Length over tube sheets	23 ft. 6 in.	23 ft. 6 in.
Tube spacing	13/16 in.	13/16 in.
Flue spacing	13/16 in.	13/16 in.
Grate area	84 sq. ft.	89.6 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	362 sq. ft.	390 sq. ft.
Arch tubes	28 sq. ft.	....
Tubes	3,497 sq. ft.	3,600 sq. ft.
Flues	1,685 sq. ft.	1,686 sq. ft.
Total evaporative	5,522 sq. ft.	5,676 sq. ft.
Superheating	1,505 sq. ft	1,500 sq. ft.
Comb. evaporative and superheating	7,027 sq. ft.	7,176 sq. ft.
Special equipment:		
Brick arch	Yes	Yes
Superheater	Yes	Yes
Feedwater heater	No	Yes
Stoker	Yes	No
Booster	No	Yes
Tender:		
Style	Cylindrical	Cylindrical
Water capacity	12,000 gal.	12,000 gal.
Fuel capacity	20 tons	(oil) 4,400 gal.
General data estimated:		
Rated tractive force, 85 per cent	78,000 lb.	70 per cent—83,500 lb.
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent.	71.2	71.6
Weight on drivers ÷ tractive force	3.69	3.61
Total weight engine ÷ comb. heat. surface	57.7	61.5
Boiler proportions:		
Tractive force ÷ comb. heat. surface	11.11	11.63
Tractive force X dia. drivers ÷ comb. heat. surface	6.99	7.38
Firebox heat. surface ÷ grate area	4.31	4.35
Firebox heat. surface, per cent of evap. heat surface	6.56	6.87
Superheat, surface, per cent of evap. heat. surface	27.21	26.41
Comb. heat surface ÷ grate area	83.6	79.9



Now is the time to check up on terminal conditions and see what should be done to get ready for winter



Freight car maintenance problems*

Need of improvements in design in order to reduce repair costs—Modern shops and equipment should be provided

By C. G. Juneau
Master car builder, Chicago, Minneapolis & St. Paul, Milwaukee, Wis.

UNDOUBTEDLY, the greatest problem today in connection with freight car maintenance revolves on the constant endeavor of the railroads to obtain the maximum use of the car unit. The utilization of cars is the product of their loading and their movement. Successful attempts are continually being made to load each car with greater tonnage and to increase the distance each car is hauled per day. Again, wherever there is an opportunity to fit the trains to the traffic, this is being done so that the tonnage will be handled in fewer trains, and thus effect a saving in those transportation expenses that fluctuate with train mileage. The trend of this endeavor on the part of the railroads to obtain greater use of their cars and trains is pictured in Fig. 1.

Result of increased weight and capacity

Along with this steady increase in the utilization of the freight car, has gone a steady change in the construction and strength of the car. The all wooden car is fast disappearing and its place is being filled by the composite car and the steel car. During the past twenty years the average carrying capacity of a freight car has increased from 29.4 tons in 1903 to 43.1 tons in 1922. The light weight of cars has also increased. The all-wooden box cars acquired in the 1890's weighed from 14½ tons to 16 tons whereas the composite box cars acquired in 1919 weighed 23½ tons. Fig. 2 shows the replacement of the all-wooden freight car by the composite and the steel car. Fig. 3 shows the increase in the average carrying capacity of freight cars of the country and pictures the trend of increased light weight of cars as shown in the case of box cars.

These changes in the weight and capacity of the freight car have resulted in its increased punishment. Although freight cars have been greatly strengthened to meet the additional burdens placed upon them, and while there is really no disagreement throughout the country covering the strength requirements of these cars, the railroads do, however, continue to have bad order cars in great numbers. What is actually occurring is increased punishment to freight equipment because of the lack of cushion formerly provided in train movement by reason of the wooden car disappearing. If operating methods are to proceed as in the past, there is absolutely no question but what resilience will have to be furnished through the medium of a suitably designed draft rigging, or else we may expect distinct failure of parts following a progressive cycle, depending upon considerations of relative strength factors.

Furthermore, while the freight car as a whole has been designed and constructed to meet modern operating conditions, many of its parts are not equal to the tasks imposed. The draft gear seems to be about the weakest part of most cars, when, as aforementioned, it must be depended on to lessen the punishment received by the car. Very little has been done to improve the foundation brake rigging, and air brake apparatus on the modern car is compared to the old unit, and yet experience shows the air brakes are responsible for approximately one-fourth of the transportation delay to cars made in bad order in train yards and running repair tracks. Rail-

* Contributed by the Railroad Division at the Spring Meeting, Milwaukee, Wis., May 18 to 21, 1925, of the American Society of Mechanical Engineers.

roads cannot well continue accepting this kind of a performance if they desire to keep the modern car in continuous service a maximum amount of time.

Importance of proper design and construction

The design and construction of freight cars was never of more importance than it is today. Each acquisition of new equipment should be made the subject of special study by the mechanical and transportation officers to determine; first, the actual necessity for the cars; second, the size and capacity which will give the greatest net returns to the company, and third, the type of car. A thorough study of the design should be made before any cars are built. It is undoubtedly true that maintenance expenses are considerably increased due to failure to take everything into consideration when preparing the designs. The only way to insure that new cars when acquired will be a credit to the mechanical department, is to keep designs of each type constantly under way. Each detail must be critically analyzed, compared with existing types and an endeavor made to eliminate its defects. A comparison of the final result with the original will usually show a surprising number of changes, and will convince any one of the necessity of giving long and painstaking attention to every new design.

Few cars designed today can be criticized as lacking in strength in the essential parts, but it is also important that cars should be light, so they can consistently be made easy to repair, and well protected against corrosion. Few cars meet all these requirements, and their failure to do so has led to severe criticism of car design from a maintenance and operating standpoint.

In the matter of designing and constructing a modern car, the details of material, as previously mentioned, cannot be judged entirely from strength requirements. The question of deterioration over a period of years needs to be given serious thought. If a roof becomes defective in one-half the time that the rest of the principal portions of the car require attention, and has to be repaired, the car is held out of service. This emphasizes the need of studying the parts in relation to their cycles of renewals, so that they may be grouped and consequently reduce the days detained on the repair tracks.

Sources of deterioration of freight cars

One of the greatest sources of deterioration of freight cars, irrespective of the material or construction, is corrosion or decay, which continuously exerts its destructive influence whether the equipment is in service or not. In the case of wood parts there are very few renewals which are not directly caused or at least greatly hastened by decay. A close analysis of failures which appear to be purely mechanical will generally disclose the gradual destruction of the piece by decay as the original source of weakness. The matter, therefore, of preventing the destruction of material, by chemical action in the case of metal and by the propagation and growth of the destroying fungi in the case of wood, is worthy of considerable study.

A car must also be considered from the standpoint of items effected by friction or transportation such as wheels, brake shoes, draft rigging, couplers and the trucks as a whole. The wear and failure of these parts constantly increases with the greater utilization obtained from the modern car. To withstand this greater hardship it is essential that proper designs and proper material be employed in each case. The use of correct metals and alloys requires a more thorough study. Certainly we never should use a brittle steel for parts subject to great shocks, or soft iron for parts subject to much friction, yet this has been done, resulting in failures. Sills, framing members, etc., are subject to strains that in time wear them out. These parts must be of such construction that shocks and vibrations incident to the service will not impair their efficiency.

Consideration should be given to building a car strong enough to meet general requirements and yet so put together, materials and otherwise, as not to be unduly heavy. In other words, cars should be designed to have a high ratio of load to total weight. This is important because dead weight is a factor in train movement. A five year average of the freight trains handled on one western road showed that for each net ton of revenue freight carried, the train hauled 1.2 tons of dead weight, exclusive of locomotive and tender. Approximately, 66 per cent of the cars hauled were loaded. It is a well-known fact that automobile manufacturers have made successful attempts to reduce the weight of automobiles, yet retaining or increasing their loading capacity. Certainly this matter needs very serious study on the part of car designers.

It is not a good policy to sacrifice materially the design

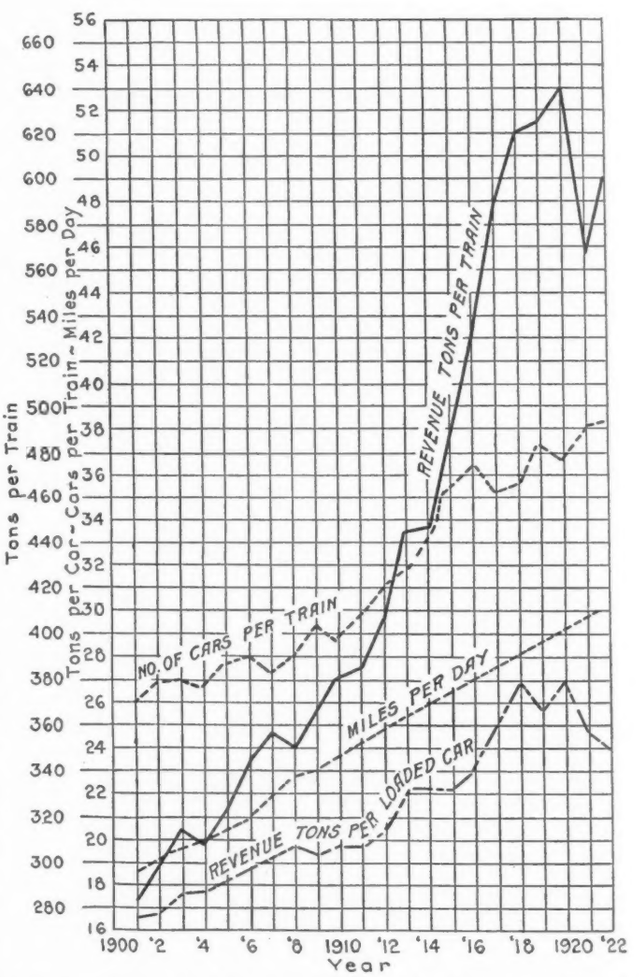

Tons per Train
Tons per Car - Cars per Train - Miles per Day
Year
REVENUE TONS PER TRAIN
NO. OF CARS PER TRAIN
MILES PER DAY
REVENUE TONS PER LOADED CAR
1900 '2 '4 '6 '8 1910 '12 '14 '16 '18 1920 '22

Fig. 1—Chart showing the increase in freight car utilization since 1900

of a car to accommodate details. Standards, however, are unquestionably excellent. At the present time details that will absolutely interchange between all different cars are too few. As long as cars are built for some particular service we may expect to have a difference in construction due to the commodity to be transported. The present tendency is toward refinement in car design and if it

continues, equipment built a few years hence will probably be radically different from what is considered standard practice today. Already a remarkable number and variety of new designs of cars have been introduced.

In the matter of maintaining freight cars it must be continually kept in mind that cars that can be kept in continuous service with a minimum cost of maintenance

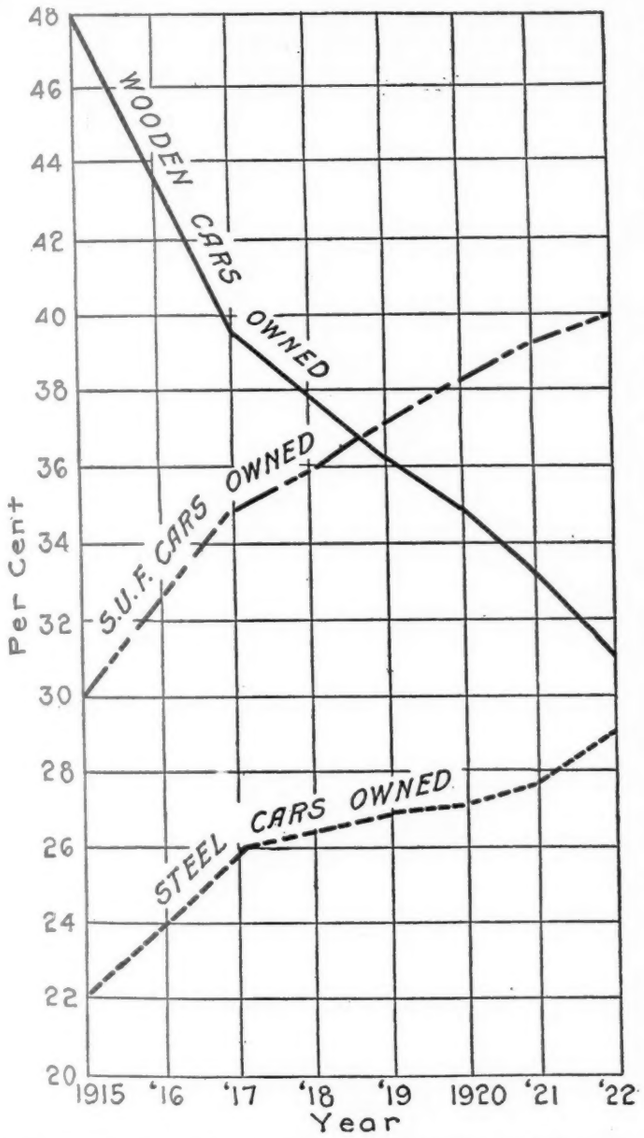


Fig. 2—Chart showing the replacement of wooden freight cars by those of composite and all-steel construction since 1915

and which are sufficiently efficient to protect the lading in transit, mean dollars and cents to the railways. One road found that during a five years' period the cars on its line averaged between 25 to 56 days per year in bad order; also that the frequency of repairs averaged between 22 to 34 times per year. In other words a defect occurred for about every 500 miles the car moved.

Freight cars subject to many defects

Freight cars are subject to many defects which make them unfit to operate. Some are of little consequence; others require considerable time and labor to repair. In general, freight car repairs are governed by frequent renewal of certain parts and infrequent renewal of other parts. Freight car repairs are roughly divided into two classes: light and heavy. Light repairs consist of work done to offset current wear, breakages and loss of parts accruing from ordinary handling and movements of cars day by day. Heavy repairs accrue, generally speaking, from three different sources: wrecks, ordinary wear and tear as accumulated over a period of years, natural deterioration, and obsolescence.

To a certain extent, the problem of handling light repairs is readily dealt with; that is, given a reasonably adequate supply of tools, material and standard parts, and a certain force of men, that part of the maintenance problem will take care of itself and cars will be switched on and off of the rip track daily without much fluctuation. It has generally been found that six light repair cars are repaired during the day to every one left over at the end of the day, and it is this feature of the work which results mostly in an increase or decrease in the bad order car situation.

The situation with respect to heavy car repairs is entirely different. Repairs to cars due to wrecks and accumulated ordinary wear and tear are usually accomplished by replacements in kind, but more extensive work is required to overcome obsolescence as in this case it becomes necessary to strengthen and remodel the cars to overcome inherent weakness in design and construction. These cars remain a comparatively long time out of service and require a comparatively large expenditure to place them in proper condition. It is in the handling of heavy car repairs therefore, that the greatest opportunities exist to produce economies and reduce the time that the cars are held out of service.

Studies made of maintenance policies and work done in repairs over long periods, particularly in relation to the life of equipment, indicate that under conditions prevailing for the last thirty years, freight cars have been given heavy repairs by owners on an average of once every eight years. In other words, at the end of the eighth year the car, if normally maintained in the meantime so far as wearing parts are concerned, would require heavy repairs, which would again make is good for another cycle of about eight years, after which it would be again given heavy repairs for another eight years of service if found to be of proper design, or would run with a limit of repairs until worn out. In this case, the life would be extended to approximately twenty-four years or more, with a few years added to the life of the car where it was permitted to run in some minor service until entirely worn out. If, at the end of the second cycle, the car was found not worth repairing, it would be run about four years longer until worn out. In actual practice there is considerable variation of these figures so that studies have developed that the average life of equipment has been approximately twenty years, particularly the body, there being a factor of safety required in the trucks which made them serviceable for about five years longer than the body. Practically all freight cars in the country have been depreciated on the basis of a twenty year life for the body and twenty-five years for the trucks, as set up by the Interstate Commerce Commission for valuation purposes.

Frequency of heavy repairs

There is no specific record of the average frequency of rebuilding or heavy repair work by classes of cars. The general data indicates an average period between heavy repairs to box cars of about nine years for those equipped with modern steel underframes and about eight years for those with wooden underframes and relative construction. Modern refrigerator cars will require about seven years between heavy repairs because of the necessity of going over the insulating feature as well as overcoming structural deterioration. Stock cars will run about nine years

due to their light construction. Coal cars will run from nine to ten years whether all steel or composite. Steel floor sheets usually last about eight years and the side sheets about nine years, so that if false floors are used for a while, the cars can be run about nine years. This has been experienced with the character of metal used in the past, which has been unable to withstand sulphuric acid coming from the coal.

The wisdom of having freight cars in good condition cannot be doubted, and the expense of maintenance is justified, particularly where the general condition of equipment is such as to require heavy work to overcome what we might call inherent obsolescence. In other words, where the proper cycle of heavy repairs as previously explained, has not been maintained in due course, there develops a degree of deferred maintenance, and to a certain extent, obsolescence, which must be overcome sooner or later.

In order to maintain a normal situation as to design, construction and obsolescence, the average age of equipment should be carefully noted at all times, as this reflects whether or not old equipment is being retired as due, and replaced with new or rebuilt equipment. It has been customary to assume an average life of twenty years for freight cars. Assuming that a road has an ownership of 100,000 cars normally at all times, then from year to year it should retire or rebuild an average of 1/20 of 100,000 or 5,000 cars, and should acquire new equipment each year equal to the number actually retired and not replaced with rebuilt equipment.

It will be noted that a road has the choice of two policies in maintaining its equipment to overcome inherent weaknesses. It can retain its equipment for a longer period by overhauling and improving existing cars, or it can retire and replace the cars with new equipment at a more rapid rate. The policy to be followed depends upon many considerations, such as finance, operating expenses, and the extent of obsolescence.

Appropriations for freight car maintenance

The matter of appropriations for freight car maintenance deserves special study. Operating revenues have many mouths to feed and when heavy retrenchments in operating expenses become necessary it is to a certain extent inevitable that the maintenance departments bear more than their proportion of such retrenchments because maintenance work can be temporarily deferred without immediately destroying the effectiveness of the transportation machine. However, injudicious savings in maintenance results in actual loss to a road through increased transportation costs and, therefore, it should be determined where economy ends and loss starts in the retrenchment of maintenance expenses. An ideal condition would be to have the repair work equalized over the twelve months' period by arbitrary charges against income in the months of great business for credit and used during periods of revenue depression.

It is costly to make repairs to cars without proper repair facilities and equipment, and conditions become worse as the weight and capacity of cars increase. It is, of course, out of the question to provide numerous costly machines and tools where only a few cars are handled, but some repair tracks that turn out as many as 100 cars a day, have hardly no equipment for expediting the work.

The labor cost of repairs made on large repair tracks is usually much too high. Careful planning of major operations, and the judicious expenditure for facilities will do much to correct this condition. This problem again is a financial one and a road has the choice of three policies to pursue; first, resort to man-power due to inadequate facilities; second, add a few machines or tools each month so as to gradually reduce the repair expenses, and, third, spend a considerable sum immediately to equip the shops and repair tracks with the needed facilities. Obviously the policy to be pursued will depend upon the road's finances though no road can long afford to pursue the first policy for the lack of repair facilities decreases net earnings. Capital account expenditures cannot be made to better advantage at this time in any direction by the railroads than through provisions for modern repair shops and equipment. In the past the amount of money expended by the railroads for logical repair shop facilities has been lamentably out of proportion with the amount of money expended for cars and locomotives, resulting

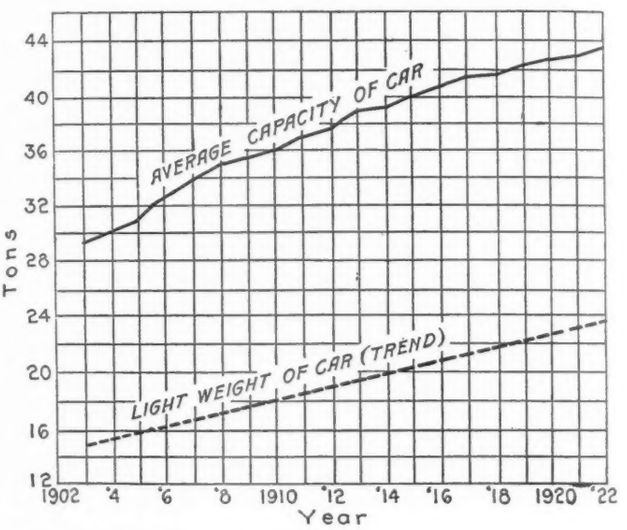


Fig. 3—Chart showing the increase in capacity and light weight of freight cars since 1902

in inadequate facilities for needed repair and modernizing work. The conclusion is that every advance in the art of car design should be met with a corresponding advance in the facilities for maintenance.

There is every reason to believe that the traffic on railroads in this country will increase as rapidly in the future as it has in the past, and that the locomotives and cars will continue to grow larger. Bigger power is demanded at all times and yet to haul a maximum train not only requires strengthening of freight cars, but roadways, bridges, engine houses, shop facilities and tools. It must be remembered, that when the freight cars are not used to the fullest degree they present a corresponding loss in all these elements, such as makes these extreme and uneven developments oftentimes show a poor net result.

Every freight car involves not only the cost of maintenance, but interest on the investment and current depreciating charges, both factors being higher because of increased investment cost. The object of the design of cars and the installation of facilities to make the maintenance cost relatively low, should be to increase the days of service by decreasing the days of detention in bad order because the greater present day cost of maintenance, interest and depreciation charges imposes upon proper railway management the requirement of greater availability for constant use.

In 1924 the Northern Pacific carried 3,607,987 revenue passengers. The average distance carried was 114 miles, and the average fare collected was $3.65. The company paid out in taxes that year $8,500,000. Therefore it required the entire gross amount received from the first 2,328,767 revenue passengers to pay the 1924 tax bill.

Air Brake Association Convention

THE following are abstracts or summaries of several papers, reports and discussions given at the thirty-second annual convention of the Air Brake Association. A brief account of the early proceedings of the opening session appeared on page 371 of the June *Railway Mechanical Engineer* and abstracts of a number of papers and reports were published on page 471 of the July issue, in which space was not available for the inclusion of those given here.

What are you specifying and getting in foundation rigging?

This report called attention to the common practice of assuming that if the piston travel (with the brakes applied) is of the proper amount and the brake shoes are of sufficient thickness to indicate lasting until the car reaches the next inspection point, or its destination, the car is in suitable condition to proceed as far as the brake conditions are concerned. Modern cars have, however, reached the stage where brake rigging is to a considerable extent hidden from view so that the time required for inspection for clearances and freedom from movable parts striking or binding, is well nigh prohibitive in trains en route, and is practicable only on the repair tracks or at lay-over points. It is therefore essential that all assurance possible be provided against such troubles by the design of the equipment and specifications to cover this design when the cars are built or reconstructed.

The report contained recommendations for the testing of air brakes on cars having both one and two brake cylinders and concluded with the following comment: "Improvement in car design seems to receive due attention in the way of applying all new features and developments that tend toward greater strength and wider ranges of utility until there is little room left on the cars for the proper installation of brakes. In view of the fact that brakes are first among the factors for safety and economy, it is suggested that when making up the design for cars it is highly consistent to provide ample room for the proper installation and operation of efficient brake equipment. This is equally important when getting up specifications for new cars or remodeling old equipment. The saving in cost of maintenance a few years later will have yielded large returns."

This report was contributed by the Northwest Air Brake Club through its committee, including Mark Purcell, Northern Pacific; James Elder, C. M. & St. P., and C. C. Ferguson, Great Northern.

Discussion

In discussing this report one member suggested that brake beam release springs are not always necessary and that half shoes be used in testing instead of removing the shoes entirely on one pair of wheels as recommended in the report. Mr. Purcell, in reply, pointed out that the removal of the shoes gives the maximum angularity of equalizers and indicates the probability of their striking parts of the car or truck and thus throwing all the braking duty on one pair of wheels, or two pairs in the case of a six-wheel truck.

To minimize the rapid wear of foundation brake gear and the development of slack it was suggested that the Committee on Recommended Practice establish a limit of at least 1/32 in. of case hardening on all brake rod and lever pins and bushings.

Report on recommended practice

The changes in practice recommended by this committee were accepted with a few exceptions. Paragraph A under air compressors was changed to read, *"Intermediate* valves should also be placed in the steam supply branch to each compressor so either can be stopped for any purpose." Throughout the entire report where the word "re-bored" was used in connection with cylinders, the words *"re-bored, or ground"* were substituted to comply with modern methods.

Under main reservoirs the association voted that a ½-in. drain cock *and Street ell* be located at the lowest point of each reservoir. Paragraph C under triple valves requiring that the ring opening positions be marked on the piston and the ring re-applied in the same position was referred back to the committee. Owing to the objections of some roads to the use of gasoline for cleaning triple valve parts and possibly creating a fire hazard, it was recommended that gasoline *or suitable cleaning compound* be used to clean all internal parts of the valves. Strong objection was made by some of the members to the use of any oil whatever in triple valves and consequently in Section K under triple valves the word *"graphite"* was substituted for "anti-friction oil."

Triple valve slide valve leakage indicator

In testing triple valves the leakage test provides that the exhaust port of the triple valve be coated with soapsuds to ascertain the amount of leakage when the slide valve is in emergency position and again when the slide valve is in release position. No limit is fixed as to the amount of leakage, so that the amount permissible is largely dependent upon the judgment of the individual test rack operator. Even if all individuals judged the amount of leakage uniformly there is a variation with the soapsuds that is independent of the operator. It has been found in testing a triple valve with one solution of soapsuds that the bubble will burst in five seconds, while another solution will hold a bubble for 18 seconds on the same valve. In addition, the temperature of the solution has a bearing upon how long the bubbles can be held.

A device lately developed, known as the triple valve slide valve leakage indicator corrects this situation and insures that all operators will judge slide valve leakage on the same basis which will permit positive condemning of triple valves when the leakage has passed a permissible value.

The principle of the slide valve leakage indicator is to cause the leakage from the slide valve passing into the triple valve exhaust to enter a chamber above a reservoir containing water. Pressure is therefore built up in this chamber which forces the water from the reservoir into a column adjacent thereto. It will be evident that the more the slide valve leaks the more rapidly will pressure be developed in the chamber above the water and the more quickly the water will rise in the water column. The rate at which the water rises in the water column is measured and this is taken as a basis for determining whether triple valves are in the proper condition.

The indicator is simple in construction but without a test code cannot be used. The following therefore covers

the test code to be used with this device. With the triple valve in the emergency position, time should be taken from the second to the third graduation and must not be less than the following: New—seven seconds; cleaned—five seconds.

In release position, the time should be taken from the second to the fourth graduations and must not be less than the following: New—ten seconds; cleaned—four seconds.

In the graduating valve tests, the time should be taken from the second to the third graduation and must not be less than the following: New—eleven seconds; cleaned—five seconds.

This report was submitted by the Manhattan Air Brake Club which is now conducting tests with the slide valve indicator, the results of which will probably be available for presentation before the convention next year.

Discussion

Several members spoke highly of this device and said that as a result of somewhat extensive use they considered it one of the most valuable adjuncts of the triple valve test rack that has been developed in recent years. The indicator is apparently not more liberal than the soap bubble test but assures a greater uniformity in the valves. In any event, reliance must be placed on the honesty of the operator since with the indicator he can permit air to leak past the rubber application end and thus give a false indication. The general feeling was, however, that the indicator will give highly accurate and uniform results.

Report on passenger train handling

In the main, this report was intended to clarify several points brought out in the report last year. After devoting some attention to the possibilities of graduated release and six different methods of making brake pipe reductions, the effect of pressure on triple valve movements was considered.

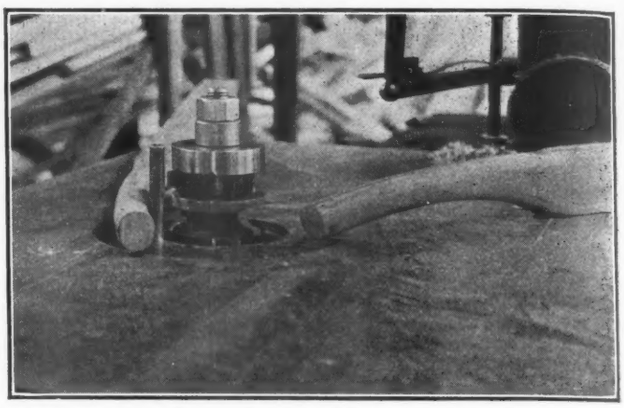
The report closed with a consideration of the relative advantages of the clasp brake as compared to the single shoe. These advantages were summarized as follows:

1.—Normal cylinder pressure per pound of brake pipe reduction.
2.—Shorter stops in emergency due to reduced brake shoe duty.
3.—Reduced brake shoe wear.
4.—Reduced brake shoe and truck maintenance.
5.—Less brake shoe dragging and reduced train resistances.
6.—Longer trains handled with less loss of time, using the same motive power equipment.
7.—Smoother stops.
8.—Fewer slid flat wheels due to shocks, stuck brakes and the transfer of load from one pair of wheels to another.
9.—Fewer hot journal bearings.

The report on passenger train handling was contributed this year by the Central Air Brake Club through its committee, consisting of James Elder, C. M. & St. P.; W. J. Devine, C. & N. W.; and L. M. Carlson, Westinghouse Air Brake Company

Device for forming handles on a wood shaper

THE usual method of forming the hand grips on wooden handles, such as used on hand trucks, is to mark out the general contour of the handles by means of a templet and then carve out the grips to shape by hand. This method requires considerable time and the finished handle is not as smooth as one turned out by the device shown in the illustration. It consists of two sets of forming tools separated by a collar. The two sets of tools, which are made from ordinary tool steel, are ground so as to form the finished contour of the handle.



Two sets of cutters quickly form the contour of the handle

The device is fastened on the spindle of a wood shaper. The handles are laid off to a templet and then quickly finished by the rapidly revolving cutters.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Wheels changed on account of owner's defect and the application of journal bearings within the thirty day period

On May 28, 1923, the Carolina, Clinchfield & Ohio applied to C. I. & L. car No. 18119, one pair of second-hand wheels and journals R. & L. No. 1, on account of a chipped rim on one wheel, the other being second hand. The old journal bearings were reapplied, as the billing repair card did not show the application of new bearings. On May 30, 1923, at a different point on the C. C. & O. system 136 miles from the point where the wheels were changed, one new solid 9-in. brass was applied to the same car at the R. No. 1 journal to replace a worn out brass. A charge of $2.06 was made against the C. I. & L. The car owner declined the charge for this journal bearing, contending that no charge should have been made for a subsequent application of a journal bearing when applied within 30 days of the initial application at the same journal location, on the same road and the same trip, as outlined in Rule 99, irrespective of whether the wheels were exchanged for owner's or delivering line defects. The C. C. & O. maintained that Rule 99 did not substantiate the claim of the car owner in that the brass removed and replaced at the time the wheels were changed on account of the owner's defects, does not constitute the initial application of the brass, and stated further that the repairing line had the privilege to decide whether or not there was sufficient service in the material to warrant renewing or replacing of the brass.

In rendering its decision, the Arbitration Committee

stated that: "The wheels were changed on account of owner's defects, and as only one journal bearing was charged within the 30 day period, the charge in this case against the owner is proper."—*Case No.* 1330, *Chicago, Indianapolis & Louisville vs. Carolina, Clinchfield & Ohio.*

Another case under Rule 32

T.A.R.X. car No. 25 was delivered by the Okmulgee Northern Railway to the plant of the Allied Refining Company on September 30, with two draft sills bent; one end sill broken; one end sill cover plate bent; one buffer casting broken; one pin lifter casting missing; one wrong draft gear Cardwell G-11-X, in place of a Miner friction gear; one wrong carrier iron; two wrong draft lugs; 18 lug bolts, which should have been rivets, and one common pin lifter which should have been full length. A defect card was demanded by the car owner in accordance with A. R. A. Rule No. 4, interpretation No. 1. The handling line refused to issue a defect card, claiming that the damages were not handling line defects, and contending that the defects were not caused by collision or impact other than that which occurred in regular switching, but by an ordinary draw bar failure, as there was no evidence that the car had been damaged due to any of the causes described in A. R. A. Rule 32. The car owner contended that the defect card should have been issued at the time of delivery according to A. R. A. Rule No. 4 which provides that the basis for responsibility should be placed according to the judgment of the receiving line under A. R. A. Rule 88. The car owner further contended that there was conclusive evidence to show that the damage to the draft gear was the result of unfair usage to the car.

In the decision the Arbitration Committee stated that: "The contention of the Okmulgee Northern Railway is sustained. The defects do not indicate delivering line responsibility. If the wrong repairs were not made by the Okmulgee Northern Railway it is not responsible for them."—*Case No.* 1329, *Okmulgee Northern Railway Company vs. Allied Refining Company.*

Proper application of temporary transverse tie rods

The Philadelphia & Reading presented bills to the Buffalo, Rochester & Pittsburgh for the application of temporary transverse tie rods to a number of B. R. & P. cars, during the months of February and March, 1923, according to Rule 21. The P. & R. stated that the temporary repairs were made because when the cars were delivered to its lines by the New York Central, in accordance with A. R. A. Rule No. 2, they exceeded its clearance limits on account of bulged sides. The temporary transverse tie rods were applied to put the cars in condition for safe movement over its line. Where the side sheets were worn or rusted, to such an extent that threaded rods could not be used, a clamp or hook end was necessary over the top angle. The P. & R. maintained that this application was proper and Rule 9 did not require the manner of application to be shown on the repair card. The car owner contended that from the manner in which the repairs were made that they were only temporary and were not chargeable against the car owner in accordance with Item *B*, Rule 21.

In rendering its decision, the Arbitration Committee stated that, "The application of transverse tie rods, according to Rule 107, Item 262, contemplates the use of rods properly secured with nuts, including necessary washers or plates at both ends. The application of the hook rods does not justify a charge against the car owner, it being considered as no repairs."—*Case No.* 1332, *Philadelphia & Reading vs. Buffalo, Rochester & Pittsburgh.*

Gondola car rebuilt in forty-five man-hours

D. & H. holds third repair contest—Three teams compete for silver cup and cash prizes

ON Thursday, May 21, 1925, the car department of the Delaware & Hudson Company held the third of a series of car building contests at Carbondale, Pa. The problem on this occasion was the rebuilding of a Delaware & Hudson standard tandem twin-hopper bottom gondola car of 85,000 lb. capacity. The work consisted of assembling the trucks and rebuilding the steel underframe and wooden superstructure. Three teams of 16 men each, eight of which were wood workers and eight steel workers, competed. These teams represented the major car repair shops on the Saratoga, Susquehanna and Pennsylvania divisions, where work of this character is a routine performance.

The cars built in this contest are equipped with steel underframes and have wood flooring and super-structure, including the side stakes. The hoppers, with the exception of the side slope sheet are also of wood construction. An idea of the size and type of the car may be obtained from the illustration showing the car rebuilt by the winning team after it had been completed and placed in service. The distance over the striking castings is 38 ft. 1 in. and the distance between truck centers is 27 ft. 5½ in. The inside dimensions of the car body is 36 ft. by 8 ft. 6½ in., the distance from the top of the floor to the top of the side being 51¼ in. The large amount of wood construction performed upon the car was an excellent test for the wood working gang, which in the case of the Susquehanna division, which won the contest, completed its work in 25 man-hours; the steel workers completing their task in a little less than 17 man-hours.

The rebuilding of the car required the driving of 847 button-head rivets and the applying of 1,015 bolts of various sizes. The painting of the car required two gallons of red lead for the underframe, 3½ gallons of black paint for the truck and frame, three gallons of metallic freight car paint and one pound of white lead. The car is equipped with Wine hopper door appliances and side and end ladders, Miner draft side castings and Harvey draft springs. The trucks are of the archbar

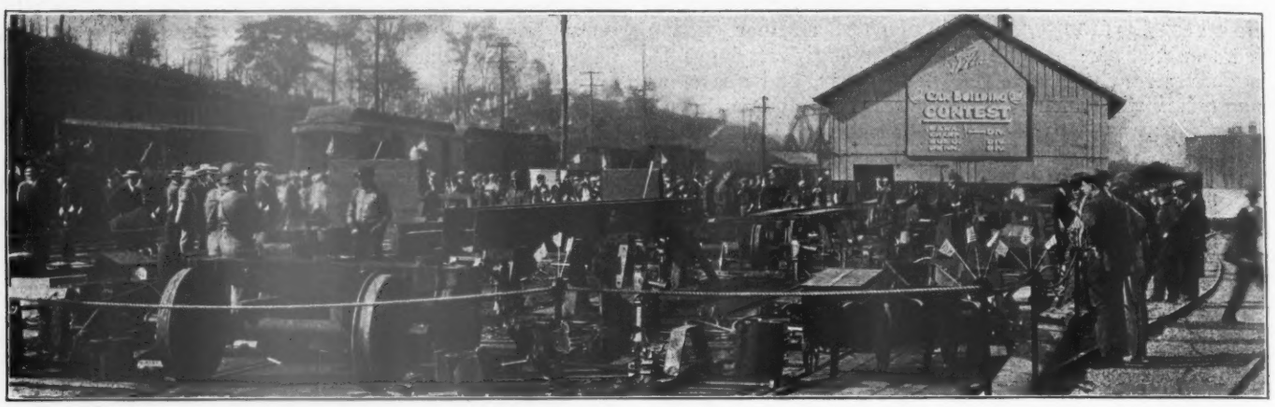
type having cast steel truck bolsters and Schaeffer bottom connecting rods, brake hangers and truck levers.

The contest was started at 8 a. m. and continued uninterrupted, with the exception of an allowance of ten minutes after the completion of the steel work in order to make the necessary preparations for the wood work, until the car was completely built.

From the standpoint of the observer, the contest was of exceptional interest. No two of the three teams performed the work alike, or had the material arranged in the same manner. The team representing the Pennsylvania division assembled the underframe and then applied the draft gear and couplers. While this work was in progress, the work of rebuilding the trucks was completed. The next operation was to apply the steps, hand holds and uncoupling levers to the underframe, after which the car was turned over to the wood workers. This gang first applied the side sills, then the hoppers, floor and the ends and sides. After the various planks were placed in position for bolting, the trucks were run under the car and the work of applying and tightening the bolts on the woodwork, safety appliances, brake rigging, hand holds on the super-structure, etc., was completed.

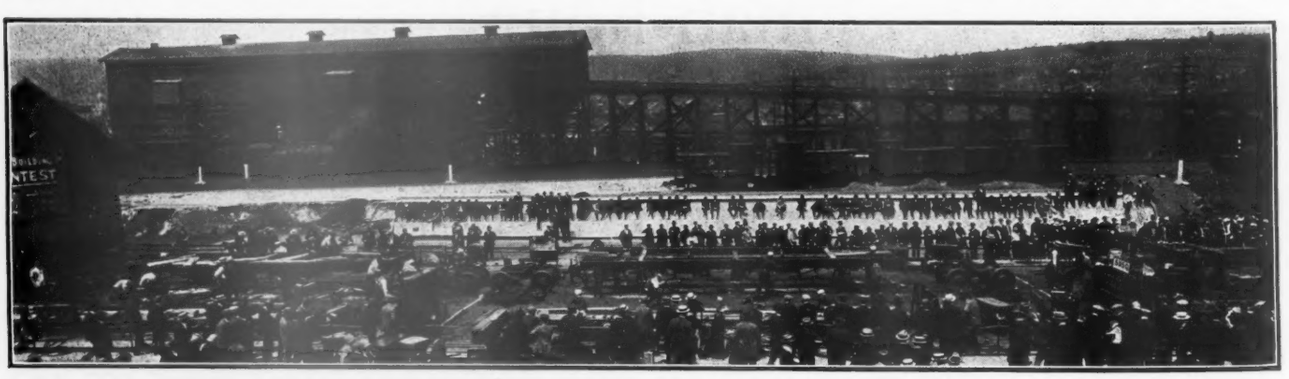
The Susquehanna division assembled the underframe and applied the side sills, hoppers and floors in the order named. While this work was being completed, the trucks were assembled and made ready to place under the car. The next job performed was the application of the draft gear and couplers and the wood workers proceeded to apply the sides and ends, steps, hand holds and uncoupling levers. Upon completion of this work, the car was raised and the trucks run under, after which the work of applying the air brake apparatus and foundation brake rigging was completed.

The team which represented the Saratoga division applied the side sills as soon as the underframe was completed, finished the hoppers, applied the draft gear and couplers, and placed the trucks under the car, the trucks being assembled while the underframe was being built. The floors, steps and hand holds were applied at practically the same time as the air brake and foundation brake rigging. As soon as the uncoupling levers had been applied, each man on the team proceeded to tighten the nuts on the bolts and finish the various miscellaneous items.



Just before the start of the contest

The most noticeable variation in the steel work was that the teams from Colonie and Oneonta allowed the center sill channels to lie flange down on the horses until the center castings, splice plates and diaphragms had been secured. This appeared to be the best practice. The Carbondale workers, however, kept the channels on edge, making it necessary to steady them while the various operations were in progress. Another feature of the steel work which attracted considerable attention was a home-devised lever dolly bar used by a Colonie riveter which permitted him to hold a rivet and buck it up at the same time. Numerous other kinks and unique practices which were wholly permissible in the contest, were noticeable both on the steel work as well as that of the wooden super-structure.



Scene during the recent car building contest held by the Delaware & Hudson at Carbondale, Pa., May 21, 1925

The Colonie team was the first to conclude its steel work, finishing at 9:57 a. m. Oneonta was second at 10:05 a. m. and the Carbondale team was third, finishing at 10:50 a. m. In explanation of the wide divergence of time, particularly as between that of the Carbondale team

and the other two, an agreement was made between the three divisional car foremen prior to the contest which permitted them to assign the truck work either to the steel crew or to the woodworkers. Of course, in actual practice, truck repairers will do this work but these men

Presentation of the Birkett silver cup

were omitted from the teams as were the air brake men and painters. Carbondale chose to have its steel men assemble the trucks and this plan would have worked very well but for difficulties encountered in the work of assembling. It was thought that this arrangement would effect better equalization of the men on the team for when certain men were no longer needed on the steel work, they could be used on the trucks. The Oneonta and Colonie teams left the trucks to be assembled by the woodworkers.

Differences in practices among the woodworkers were also noticed by the manner in which they handled the side sills. It was generally agreed that the Colonie team used the best method: namely, that of allowing the sills to lie flat on the horses until the stake pockets had been secured by U bolts, after which the sills were turned over and the nuts run down with an air machine. Portable scaffolding appeared to be an advantage to the Oneonta team as compared with the ladders used by its competitors when bolting the side stakes, corner bands, securing the Wine ladders and other outside appliances.

The Susquehanna division team was the first to complete the task, which required 5 hr. 20 min., making a total of 42⅔ man-hours, exclusive of the air brake work, painting and stencilling. Adding this work to the total man-hours required to build the car, the entire job of rebuilding, painting and stencilling the car required a total of 45⅓ man-hours. The time required for this team to perform the various major operations was as follows:

	Man-hours
Trucks completed	1 hr.
Steel work	16 hr. 40 min.
Wood work	25 hr.
Air brakes	1 hr. 10 min.
Painting and stenciling	1 hr. 30 min.
Total	45 hr. 20 min.

At 4 p. m., approximately one hour after the Susquehanna division had completed its work, the first car was spotted and loaded at the coal breakers at Carbondale and left that point 55 min. later, destined to Wakefield, Mass., via the Boston & Maine.

The judges were P. Alquist, master car builder, Delaware, Lackawanna & Western; W. G. Knight, mechanical superintendent, Bangor & Aroostook, and C. P. Pfeiffer, master car builder, Buffalo, Rochester & Pittsburgh. This committee inspected each car upon the completion of each major operation and also made a

The winners—Susquehanna division team

Seated (left to right): Alex. Ushtwant, Henry Neilson, Horace Landry, Fortunatus Kattansick, Percy Brush and Fred Lamb. Second row: John Knosvitch, Joseph Dilello, Lee Coburn, Warner C. Arndt, Albert Dilello and Fred Demesko. Standing: Claude E. Gregory, piecework inspector; Ross J. Comstock, foreman steel gang; Egnu Solowich, Daniel Patrick, Herman Wells, Louis Colone, Mike Truchan, Elmer Young and Rathbun J. Cook, foreman wood gang.

final inspection after the work was completed. It reported that in its opinion, the work of each team was of an equally high standard so that the status of each was fixed by the time required to complete the work. The prizes were awarded by Colonel J. T. Loree, vice-president and general manager, Delaware & Hudson, who was an interested spectator throughout the contest and complimented the winners on their excellent performance which won them the contest.

Approximately 500 persons witnessed the contest and the awarding of the Birkett silver cup to the Susquehanna division team for the second consecutive time. This cup is dedicated to the memory of the first foreman of the car department of the Delaware & Hudson. In addition to the cup award, each man on the winning team received a cash prize and a further cash prize was awarded to the Saratoga division team, which took second place.

Representatives of 23 railroads and 34 railway supply companies, as well as two inspectors from the Interstate Commerce Commission, were registered in attendance at the contest. A box lunch, prepared by the wives of the supervisors of the car department of the Pennsylvania division was served in the wood mill during the noon-hour to the guests of the Delaware & Hudson.

These contests, of which this was the third, are entered

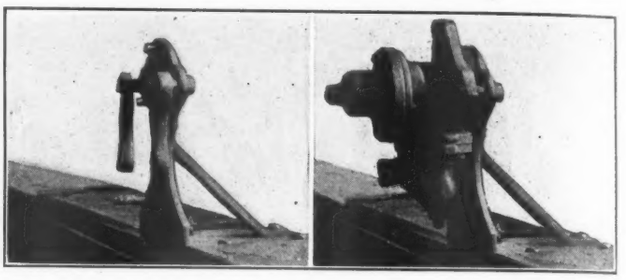
Car built by the winning team ready for service

into with a friendly spirit of rivalry and are not only interesting, but also instructive to the employees. One of the outstanding features is the material layout, which indicates in many respects efficient and economic car shop operation. The compensation of the employees in the car department is fixed on a piece-work basis and these contests afford an ideal opportunity to study that phase of car repair work. The ready accessibility of material stimulates production and the resultant increased output is reflected in the earnings of those on a piece-work basis.

The first of these contests, which was described in the January issue of the *Railway Mechanical Engineer,* was held at the Colonie shops on October 31, 1923. Five teams of six men each, selected from the major shops of the Delaware & Hudson participated, the winner of that contest being the Carbondale team which completed the task in 7 hr. 49 min. The second contest was held at the Oneonta shops of the Susquehanna division on May 8, 1924, at which time the super-structure of a 60,000-lb. capacity steel-frame box car was rebuilt and the trucks and draft gears assembled. Three teams of eight men each competed. The winner was the Susquehanna division team which performed the work in 6 hr. 30 min., or 52 man-hours.

A handy device for holding triple valves

A DEVICE for holding triple valves while they are being repaired is shown in the illustration. It is made of ¾-in. steel plate bent to 90 deg. and braced as shown. The working face of the holder is provided with two pins that fit snugly into the upper and lower bolt holes of the triple valve and two locking handles having inside



Left—Holder ready to receive triple valve; Right—Triple valve in position

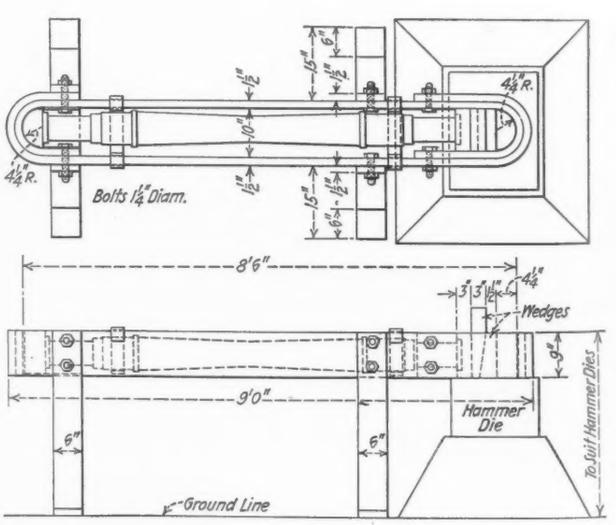
cam surfaces. The triple valve is placed on the holder by inserting the pins through the bolt holes and turning the locking handles upward. The cam surfaces serve as a wedge to hold the triple valve securely against the working face of the holder.

Tool for upsetting car axles

By F. L. Clark

Blacksmith foreman, Southern Pacific, Algiers, La.

THE reclamation of worn car axles is a perplexing problem which most all car departments have to contend with and many tools have been devised for upsetting car axles which have been more or less of a success. The tool shown in the illustration is simple in



Method of holding the axle during the drawing out and upsetting operations

construction, easy to handle and gives very good results.

The axle is first drawn out to length and then straightened in a centering machine to make it run true. Each end of the axle is then heated and upset so as to obtain

sufficient stock to make the collar after which the journal is turned on a lathe to make a new fit.

It can be seen from the following table that the axles are reclaimed until they are down past the lowest limit.

Size	Capacity in lb.	Amount center is drawn out	New size	Capacity in lb.
5½ in. by 10 in.	100,000	1¾ in.	5 in. by 9 in.	80,000
5 in. by 9 in.	80,000	1⅝ in.	4¼ in. by 8 in.	60,000
4¼ in. by 8 in.	60,000	1½ in.	3¾ in. by 7 in.	40,000

With this tool the center is drawn, each end upset and the journal turned for a new fit for $7.35 which includes labor and material, charging the axle at scrap price. Forty-five axles—90 ends— are upset in 7 hr., 20 min., which includes the trucking time to and from the shop.

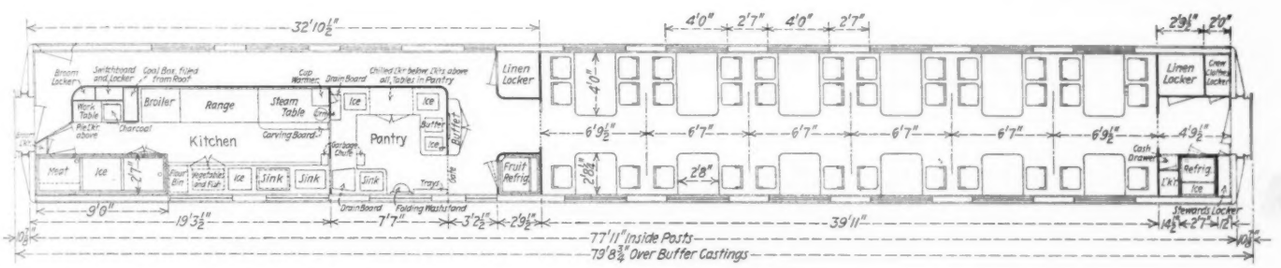
St. Paul to rebuild dining cars

THE Chicago, Milwaukee & St. Paul contemplates rebuilding its wooden dining cars with seating capacity for 30 guests, into 36 seat, steel underframe diners, and the first sample car was recently completed at the railroad company's shops, Milwaukee, Wis.

greater working room, as well as to provide locker space to make the car suitable for Coast line service. The practice on the C. M. & St. P. is to stock dining cars in Coast line trains at Chicago and Tacoma, Wash., the two terminals, and it is, therefore, necessary to take provisions for a 75-hour run. For this reason, an unusually large refrigerator is provided.

It will be noted that the refrigerator compartment near the end of the car has space for meat hooks, so that entire sides of beef can be placed in this compartment. The refrigerator is of the modern type, being iced from the roof. Other features in the kitchen and pantry are indicated on the floor plan.

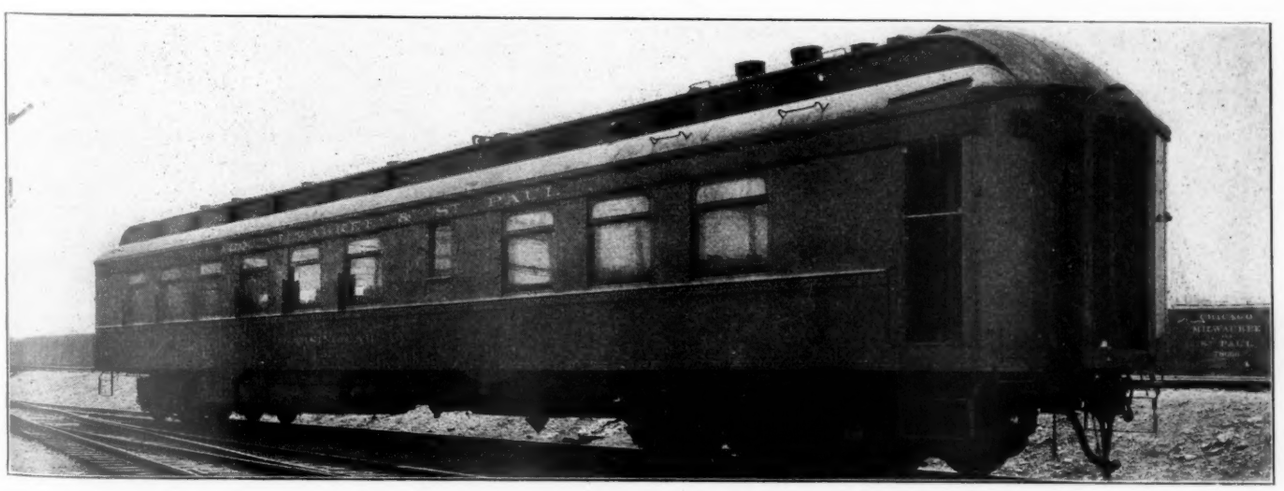
From the illustrations it will be noted that the usual standard depth of underframe is employed. In order to make provision for such an underframe, it was necessary to replace the wooden center sills with stringers and bring the steel underframe up close to the floor in order to obtain the usual clearance from top of rail to bottom of center sill. The object of making the sill of standard depth was to obtain an underframe together with the side sill construction of adequate strength to carry the



Floor plan of rebuilt C. M. & St. P. diner—Six additional seats in the dining room and unusually large kitchen space are provided

The rebuilt car is equipped with a steel platform and steel side girders of adequate strength to carry the weight of the car, equipment and passengers without the use of truss rods. The original car was of the ordinary vestibule type and in order to provide two additional tables

weight of the car body and equipment without maintaining the truss rods, originally under the wooden cars. A center sill of less depth than 26 in. in this case proved to be unsatisfactory from an engineering standpoint, when buffing stresses and direct leads were considered.



C. M. & St. P. diner recently rebuilt at Milwaukee shops—Steel underframe applied—Seating capacity increased

the end bulkheads of the car were moved out to the buffer beams, eliminating the side doors with the exception of one door at the kitchen end.

The arrangement in the kitchen and pantry is new, as additional space had to be provided in order to obtain

It will be noted that the center sills project 5¼ in. above the top surface of the cast steel double body bolster and platform casting. The reason for this offset is to avoid as far as possible alterations in the present wooden underframe, as with this construction it is only neces-

sary to remove the wooden center sills at the distance equal to the length of the steel underframe, leaving the platform intact. It will be noted that the platform casting is of the vestibule type, this arrangement permitting the use of a standard underframe construction for both vestibule and blind end cars.

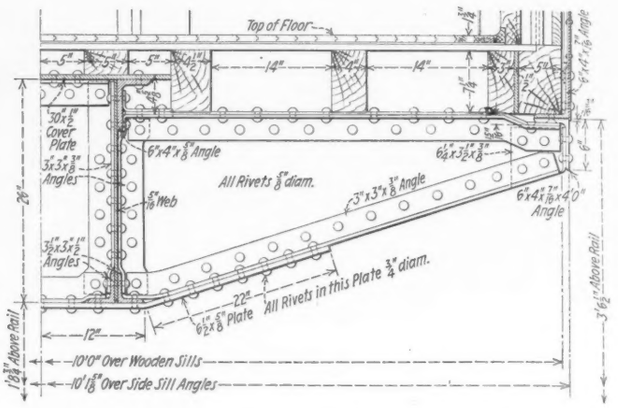
The interior view of the car creates an impression both of simplicity and of beauty

Interior finish and decoration

It will be noted that the contour and ceiling decoration is a departure from present practice, inasmuch as practically all moulding has been eliminated. The ceiling consists of a three-ply veneer covered on the underside with a heavy burlap, the painting being light cream, stippled. The side finish is plain Cuban mahogany without any inlay or ornamentations.

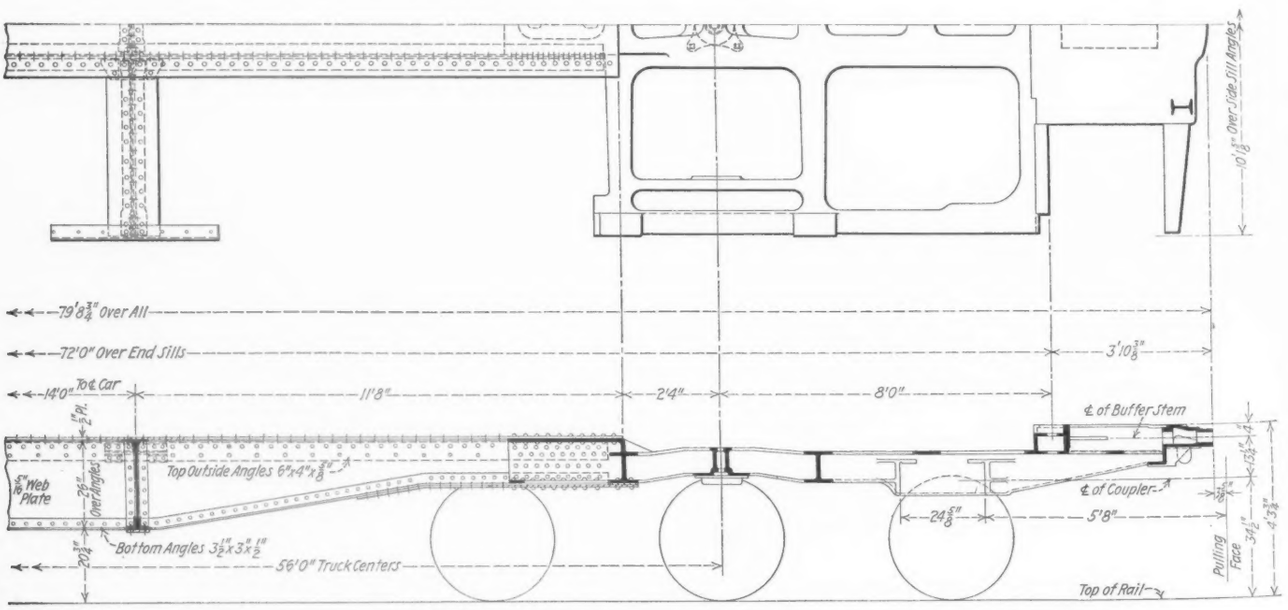
The chairs are upholstered in black leather to match the carpet, which has a black background with a floral pattern in Chinese red. The side lights are especially designed for this car, with parchment shades, hand painted. The ceiling lamps as well as the base of the ceiling fans have special ornamentations to match the side fixtures.

From the interior view it will be noted that the buffet is built to a height as used in dwellings. This was made to obtain a homelike appearance in the car. In place of the ordinary decksash, it will be noted that shutters in the form of grills are introduced in the upper deck.

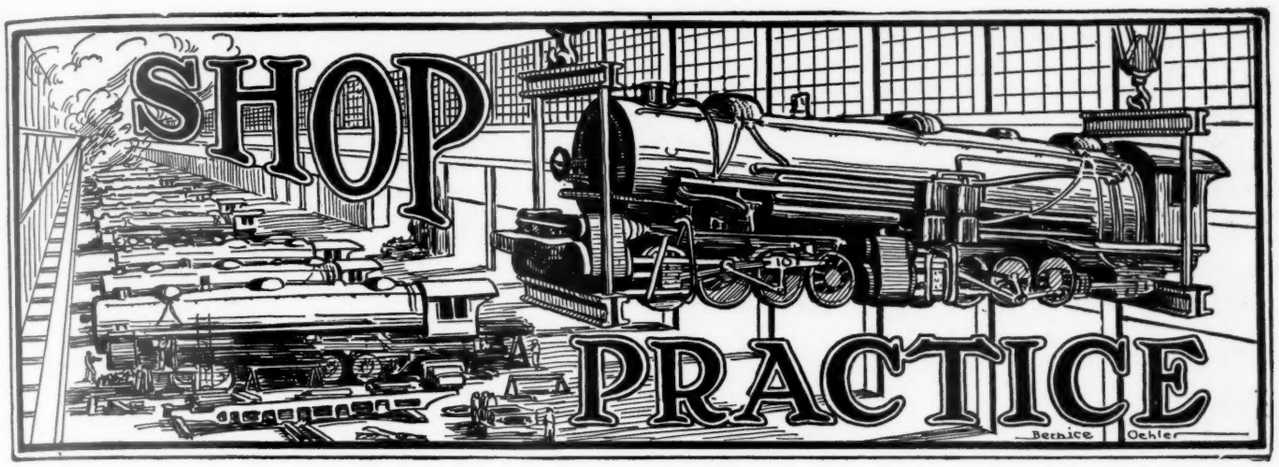


Cross-section showing arrangement necessary to accommodate the increased depth of center sill

PRIZES of $25, $20, $15 and $10, and six prizes of $5 each are being offered by the general loss and damage prevention committee of the New York Central for the best articles containing practical suggestions for the reduction of loss and damage to perishable freight. The prizes are offered in connection with a campaign now being conducted by this road, as a means of further reducing damage to perishable freight. The contest is open to all employees of the New York Central except agents at Class A, AB, B and C stations, general yardmasters and assistant general yardmasters, and supervisory officers of other departments occupying positions of similar rank. The papers submitted must contain not less than 500 words and not more than 1,000. The contest ends on August 31.



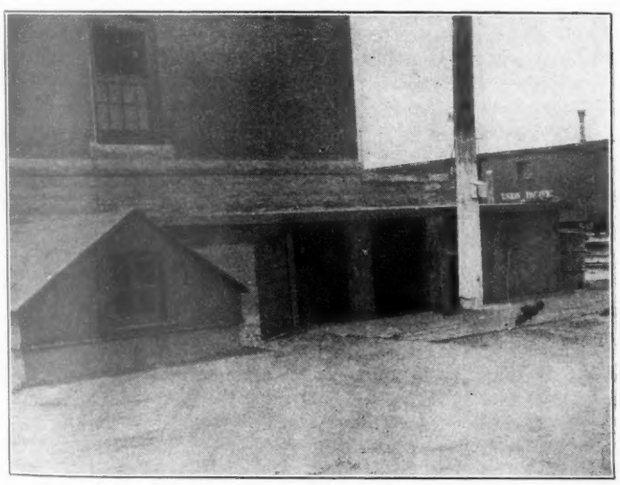
General arrangement of center sill and platform casting—Standard depth, 26 in. sill used



Handling locomotive supplies

Judicious location of the building containing supplies saves time, labor and material

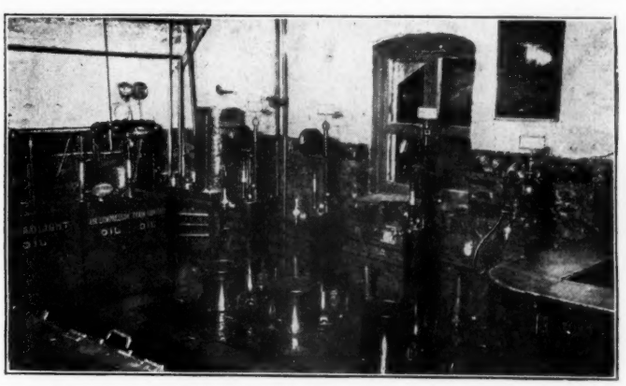
THE overall efficiency of an enginehouse in turning locomotives is dependent on the efficiency with which individual maintenance and servicing operations are performed, and one of these operations involving a magnitude of expense not always appreciated is handling engine supplies. The problem of efficiently supplying oil and other materials to engines was studied at the Union Pacific enginehouse, Cheyenne, Wyo., and a method developed which, having proved its merit, may be of suggestive value to other railroads.



Fifty-gallon oil barrels on two-wheel trucks are run into this shed from which they drain to the oil storage tanks in the supply house basement—The shed is air tight and heated in winter

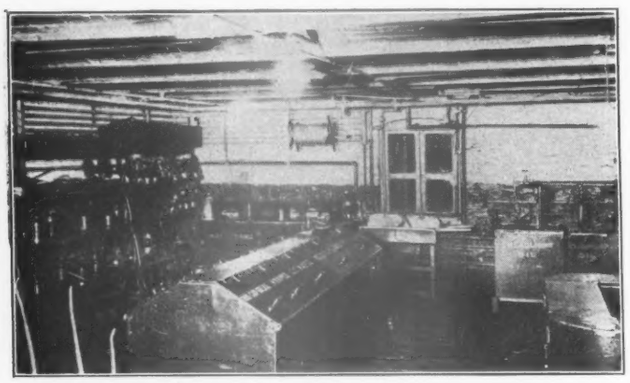
The method formerly in force at Cheyenne was to bring each day's supply of oil and materials needed for the engines from the general storehouse, located comparatively near the enginehouse but still too far away to be a convenient base of supplies. Time was lost going to and from the storehouse and it was impossible to maintain an accurate control of the materials issued. The brick building, shown in the illustrations and formerly used for waste reclamation and storage, was therefore converted into a supply house for engine oil and other materials. Being located adjacent to both the inbound and outbound tracks, it forms a convenient base for engine supplies which can be handled with much less labor than formerly. Material is saved and the entire operation of handling engine supplies is brought under the closer supervision of the enginehouse foreman with a resultant increase in effectiveness and economy.

During times of peak load 100 locomotives are handled at Cheyenne in 24 hours and by means of the new supply house conveniently located and fully equipped, it has been possible to reduce the number of men engaged in handling engine supplies to one man on each of three shifts, with a laborer on the day shift. When an engine comes to the enginehouse, the light supplies are taken off by the supply man, assisted by the hostler. When the engine is ready to be dispatched the supply man takes out valve oil, car oil, fusees, torpedoes and flags. Since the Union



Interior view of the engine supply room showing Wayne oil pumps—Lubricators are drained and the oil strained for re-use

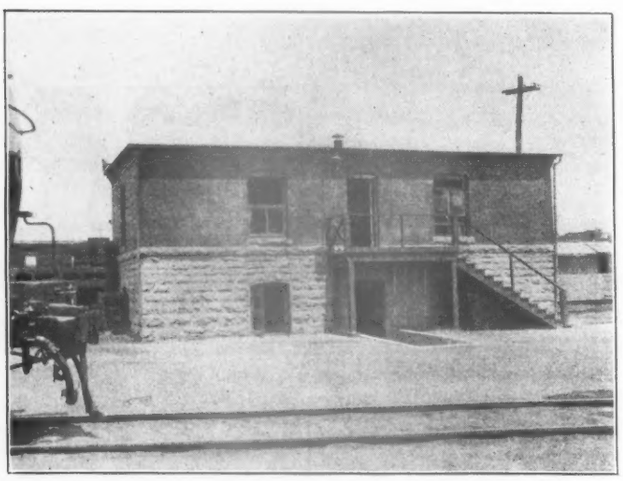
Pacific locomotives are practically all in pooled service, each locomotive carries its individual set of tools which are locked in an ingenious holding device on the front of the tender. These tools, therefore, are seldom lost, and need not be renewed except in case of breakage. The supply man also brings out to the locomotive lanterns, waste and a torch and checks the engine for the heavy supplies, including rerailers, switch chains, clinker hook, spout hook, shaker lever and knuckles. The supply man



Orderliness features the engine supply house, a place being provided for everything and everything being kept in its place—The sectional waste container is shown in the foreground

watches the dispatcher's board to see that outgoing engines are furnished with supplies in ample time to avoid delay.

The engine supplies are kept in the basement of the building, the other floor being occupied by two offices. Access to the supply room is readily had through the basement door shown in one of the illustrations. The arrangement of the interior is also clearly shown in the illustrations. Oil is furnished by means of four Wayne oil



Engine supply house reconstructed from waste reclamation and storage building at the Cheyenne enginehouse of the Union Pacific

pumps which draw from storage tanks beneath the basement floor. Oil is moved to the supply house in 50-gal. barrels on 2-wheel trucks which are run into a practically air tight shed built at one end of the supply house and piped to the storage tanks below the pumps. In winter the doors of this shed can be closed tight and, by means of steam coils on the inside, the temperature kept at a point where the oil will flow freely from the barrels to the storage tanks.

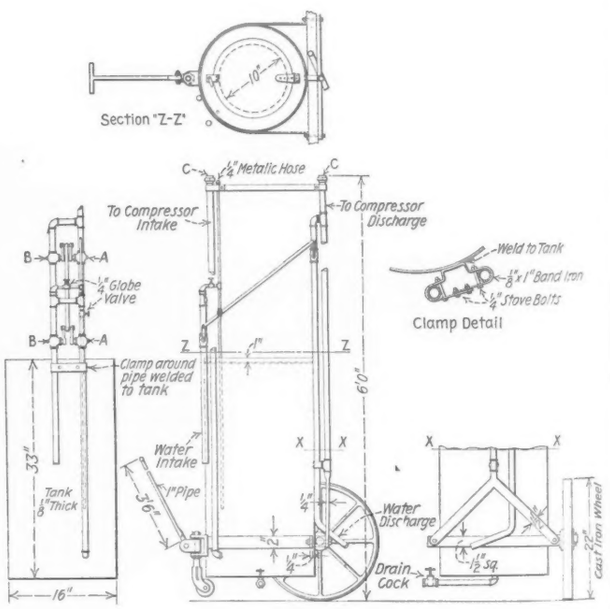
The engine supply house is kept very neat and orderly with a place provided for every item. Lanterns and torches are cleaned at the bench adjacent to the lantern storage rack. Lubricators are drained and the oil strained and re-used in order to eliminate as far as possible all waste of oil which represents just so many dollars and cents. Cellar grease is reclaimed by the regular supply men in their spare time. The grease as received at the supply house in barrels is picked over by hand to remove the dirt. It is then formed in cakes of specified standard sizes by means of dies in a pneumatic press. Thin cakes are built up to standard thickness by adding layers of the required thickness at the bottoms.

The experience of the Union Pacific with this carefully laid out and operated engine supply house indicates that the time and effort expended on it are well worth while. It makes possible considerable savings over the more common type in which the attempt is made to keep engine supplies in an old box car body, having neither room, light, nor facilities for handling any considerable amount of material.

Air compressor laundering equipment

ONE of the subjects discussed at a recent meeting of the Manhattan Air Brake Club was the method for laundering air compressors. Among the various devices proposed as giving excellent results was one used on the New York Central Lines East.

The laundering machine consists essentially of a tank



Drawing showing the construction of the air compressor laundering device

mounted on wheels and equipped with the necessary pipe and hose connections. Referring to the drawing, connections are provided to the compressor intake and discharge by means of six-foot lengths of ¾-in. metallic hose with suitable pipe fittings on either end. When circulating potash through the compressor, the cocks *A* are opened and the cocks *B* closed. When it is desired to circulate clear water through the compressor, the cocks

A are closed and the cocks *B* are opened. All pipe and fittings are ¾ in. with the exception of the steam line which is ¼ in.

The solution tank is 33 in high and 16 in. in diameter and is made of ⅛-in. steel plate. The top head is provided with an opening 10 in. in diameter which is sufficiently large for large pieces of potash to be dropped into the tank. This eliminates the necessity of having to break the potash into small pieces which is an unpleasant job, because the dust gets into the eyes of the workmen. This arrangment also eliminates the necessity of having to melt the potash into a solution before it is placed in the tank. The opening on the top of the tank is provided with a cover to prevent the solution from being splashed out on the workmen when engaged in starting the air compressor or moving the tank about the enginehouse.

The solution is kept hot by a steam connection to the compressor drain cock. Thus a connection to the shop steam line is not required. A tank of this capacity permits one charging of the solution to be used a number of times. Owing to the size of the top opening, the laundering machine may be used for cleaning parts other than the air compressor, such as feed valves, pump governors, etc.

A duel circulating system is provided for both solution and clear water. It will be noted from the drawing that the circulating pipe system is arranged in such a manner as to prevent water from getting into the solution and diluting it. A fresh water connection on the equipment affords a quicker way of circulating clear water through the air compressor than is possible when the laundering device has to be disconnected, the compressor shut off and a water connection then made at the compressor. In other words, when this device is connected to the air compressor and started, there is no need to make any further adjustments, except to turn cocks *A* and *B*, until the job of cleaning is completed.

The design of the laundering machine is such that the weight is reduced to a minimum and is balanced around the axle which permits easy handling by the workman. The wheels are 22 in. in diameter which allows the machine to be hauled readily over rails or small obstructions on the floor.

Master Blacksmiths meet at Cleveland

Many new methods are proposed and discussed— Development of welding has reduced blacksmith shop costs

THE International Railroad Master Blacksmiths' Association held its twenty-ninth annual convention at the Hotel Winton, Cleveland, Ohio, August 18-20, 1925. There were over 110 members in attendance. Two factors stood out prominently in the discussion of all of the reports, namely, the effect that the rapid development of welding has had on blacksmith shop work and the need of having proper and adequate machine tools and shop equipment. This latter factor was emphasized by trips to the plants of the Acme Machinery Company, the Ajax Manufacturing Company and the second machine tool exposition of the National Machinery Company, Tiffin, Ohio.

It was decided to hold the 1926 convention at Cleveland. The following officers were elected for the ensuing year: President, H. W. Loughridge, P. & L. E., McKees Rocks, Pa.; first vice-president, L. C. H. Weideman, C. C. C. & St. L., Beach Grove, Ind.; second vice-president, W. W. Shackford, A. C. L., Waycross, Ga.; secretary, W. J. Mayer, M. C., Detroit, Mich.

Jas. J. Egan (N. Y. N. H. & H.)
President

H. W. Loughridge (P. & L. E.)
First Vice-President

W. J. Mayer (M. C.)
Secretary and Treasurer

Abstracts of a number of papers which were presented at this convention follow:

Autogenous welding

Two papers on autogenous welding were presented by E. M. Turner, A. C. L., Rocky Mount, N. C., and C. K. Abbott, L. S. W., Tyler, Texas. Autogenous welding has come into shop practice so rapidly and has

speeded up shop efficiency to such an extent that we find ourselves asking the questions: How did we get along before we had it, and what would we do now without it? Autogenous welding has probably saved the railroads more money and time in the repair and upkeep of worn and broken parts, especially that of locomotive frames, than any one process ever introduced into the railroad shop. In addition, many intricate forgings can now be made on short notice and with less expense.

It was generally conceded that both the acetylene and the electric methods each had its place and that one had advantages over the other on certain jobs. In some shops it is the practice to require all welders to make a test weld every three months and the men making the best test are the men put on the best class of work. In many shops practically all of the boiler welding is done with the electric method, as well as link motion work, while frames and cylinders are welded with oxy-acetylene with good success.

One speaker said that his road used both methods at the reclamation plant. Each job of welding and cutting is followed up by a competent welding supervisor who is requested to keep a close check on the cost of the different operations.

There was also considerable discussion as to the relative merits of thermit and oxy-acetylene welding for repairing locomotive frames. It seemed to be quite generally agreed that thermit produced better results around the pedestal jaws, but considerable pains should be taken to properly preheat the frame and also to retain the heat around the "V." The use of asbestos lagging is now recommended as satisfactory for this purpose. Allowance should also be made for expansion in both the upper and lower rails of the frame. In case the fracture is in the top rail, the lower rail should be cut to permit equal expansion. One of the speakers also recommended heating the frame on the opposite side of the locomotive and then annealing the welded portion so that both sides would be alike.

The development of the otheograph for cutting out parts of locomotive frames, chains, hooks, etc., was also commented on. Cutting out parts by this method has effected a considerable saving over the old methods of forging. In cutting iron by the use of the torch, it is not necessary to preheat, but steel should be preheated and annealed afterwards.

Carbon and high speed steel

By J. H. Hill

Blacksmith foreman, Chicago, Burlington & Quincy, Aurora, Ill.

The tool temperer should be provided with facilities to closely duplicate the different hardening and drawing heats required by various classes of tools. Compare a forge fire, radiating heat from one direction, the heating of one tool at a time and a tool temperer's eye as the best gage, to a properly constructed furnace heating slowly and evenly a number of pieces in the same time and the correct heat ascertained by a pyrometer. It can be seen that such facilities are necessary to economical and efficient duplication of the tool temperer's work.

Our products are charged with the expense and we are held accountable for the results of these tools. It thus behooves us to become informed on modern tempering equipment so we can make recommendations and use our influence to get these facilities.

Keeping the tool temperer informed as to the results of service obtained from the tools is necessary to attain high efficiency for the most modern equipment. It is in no way a self-operating device, but it will, with the co-operation of the tool foreman and the tool temperer's knowledge, give the results for which we aim.

The hardening or refining heat is of the most importance, for it is the base and a one hundred per cent tool can not be produced unless this part of the work is done correctly. There are three different methods used in ascertaining the correct hardening heat, all of which are good, and in a measure depend upon the mechanical equipment. If the furnace is equipped with a pyrometer, reduce the heat of the furnace below the hardening heat. Place the pieces in the furnace and have the thermo couple arranged so that the slightest change in the heat of the piece will instantly show on the pyrometer. Then set the regulators so that the heat is slowly advanced and when the hardening heat is reached a slight pause is noted on the pyrometer which indicates the hardening heat. Small furnaces are manufactured which are sensitive enough for this particular work.

The second method is the magnet and it is used in the following manner. Couple the magnet to a light socket or to a battery system. The magnet is balanced on a rod so that the back end is slightly heavier than the front end or magnetic point. Reduce the heat of the furnace below the hardening point. Place the piece in the furnace and set the regulators so as to obtain a slow rising heat. Then apply the magnetic point to the piece being heated. When the heat gets close to the correct hardening heat, the piece will cease to attract the magnet and the slightly heavier back end will cause it to change position, which is a notification to the operator that the hardening heat has been reached.

The third method is one that has been used for many years and is as reliable today as it ever was and is as follows. Turn a test piece one inch round and about three inches long. Then nick on one side and temper at the lowest heat which will make the piece file proof. Fracture and examine the grain which will, with practice, enable the tool dresser to determine if it has received the correct heat. It will further enable him to pass judgment on a tool that has broken in service and if the grain is right, prove that some other than incorrect hardening is the cause and thereby save breakage of future tools used for that particular purpose. The correct time required for heating has been worked out in several ways and the following general system gives the best results: The correct hardening heat of a tool, we will say, is about 1500 deg. F. The regulator of the furnace is set to maintain that heat. Then lay the tool on the floor of the furnace and move it every few minutes, noting if the spot on which it was lying is darker than the rest of the floor. If the floor is darker, the tool is not heated through, but if the spot shows the same color as the rest of the surface, it is heated through. It should be left to soak five minutes to each inch of thickness after the spot on the floor is gone.

Drawing the temper of tools made of carbon or high speed steel is done to relieve them of hardening strains, which are set up throughout the tool. The drawing heat, to be efficient, must be through the entire piece so that the core as well as the outside wall is benefited. This is also a point to be considered in examining fractures.

An epidemic of breakage occurred in the fillet of the shank of beading tools. Examination of the fracture of the tool showed the core to be file proof. The outside surface, however, could be readily touched by the file. This proved beyond doubt that the tools had been overheated in tempering and a quick drawing heat had been produced. The color on the surface had not

benefited the core. As a result we always check the drawing heat in oil.

One other point on the drawing of temper that we endeavor to make is to draw at the lowest heat which will satisfactorily answer our purpose, for the lower the drawing heat the harder the tool. It is the rule rather than the exception, that the harder tool will give the best results.

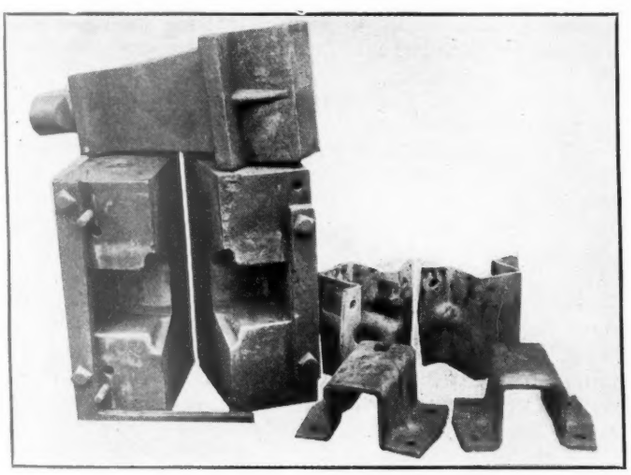
We have handled a large amount of carbon and high speed steels and most always get good results by following the instructions given us by the steel men. In 1919, when it was hard to get tool steel, our tool room foreman had 12 sets of dies and punches to make for forming copper ferrules for flues. These dies had to be gotten out in a hurry and as we had no tool steel from which to make them, we made them out of scrap pieces of Nychrome steel side rods. These punches and dies when properly heat treated have made thousands of copper ferrules in the past six years and are still in good shape.

Drop forging

By F. P. Deissler

Blacksmith foreman, Bessemer & Lake Erie, Greenville, Pa.

Concerns that have made a business of drop forging are, of course, better equipped with machinery and capable men to work out their dies. This is important, for if your dies are not right, you cannot get the required results. The average railroad blacksmith shop does not have drop hammers because of not having

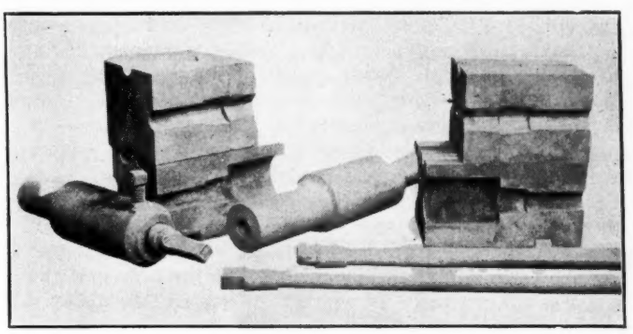


Dies for forming stake pockets

enough work to justify the installation of such a tool, but practically all have steam or power hammers of some description, or at least should have. We do considerable work that we call drop forging in our shop, but we use the pocket die method and get fair results. The dies used are not expensive and doubtless the results obtained are as good as can be done without a drop hammer.

We make our own dies in the blacksmith shop, except shaping the edges and drilling. We first make a master piece of the article we want, taking a little care to get it as nearly the exact shape as possible, except in thickness which we make ⅜ in., or more, too large. We then forge two pieces of steel so as to have at least 1½ in. thickness at the bottom of the impressions and enough larger than the impression so as to have at least 2 in. on all the edges. We then reheat to a good soft heat, clean all the scale from the faces and place the master piece between these two blocks and press or drive them under the hammer until the edges come close. We then take them to the machine shop and have the faces planed off so the impression will be the correct depth in each, the master piece being thicker than the finished piece.

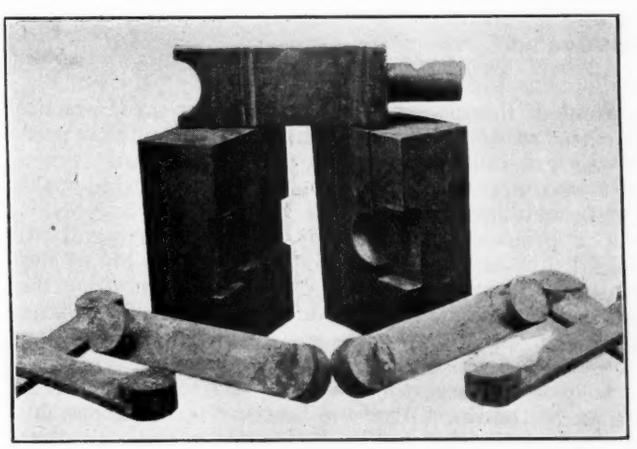
This brings the edges of the impression to a good edge; otherwise they would draw in and leave too much opening at the edges. We then have them planed to a given size on the outer edges, placing a finished piece between so as to be sure that the impression and outside



Dies and headers for forming taper crown bolts

edges are correct. We then make a band, the size of the blocks and about 2 in. higher than the bottom one, so as to receive the top block which should be loose enough so as to enter freely and guide it to the proper position. The impressions should have about 1/16 in. chipped back about ½ in. or ¾ in. for splash.

For work which is done from the end of the bar, a slot can be cut in the band for an opening to receive the bar. Where the piece is made from a block this is not necessary. There is one thing to remember, that the stock should be of the proper amount and shape and good soft heats used. I believe that more failures come from these two reasons than any other. After passing the piece through this tool and allowing it to cool, the



Dies for forming locomotive spring hanger ends

fin or splash is trimmed cold. The trimmer is a piece of hardened tool steel the shape of the piece which is being worked. This block is placed on the hammer die and the forging is driven through.

Discussion

Drop forging is not a game to play with for it is a difficult problem to study, especially with the idea of reducing costs. It was generally agreed that dies used

in shop forging work should be made of special steel and not from scrap material, such as old car or locomotive axles. Some scrap axles will harden, while others will not, so such material is not always dependable for making dies. Fine steel usually stands the wear pretty good but it is not as good as steel made especially for die blocks.

Drawbars and pins

By Alexander MacDougall

Blacksmith foreman, Bangor & Aroostook, Derby, Maine

We have three kinds of conections, namely: the solid bumper, wedge and spring. We find that the solid bumper and wedge are hard on the drawbars and pins. The spring bumper is applied as the locomotives go through the shop. The slack is taken up at the engine house by putting a plate between the bumper, or back of the spring. These are removed as the locomotives go through the back shop and the bar is made to the proper length. If the holes are worn oblong, they are upset to the proper size and if the metal between the hole and the end is too thin, a piece is welded on the end to make it the proper thickness. The solid bars are made of hammered iron and the pins of machinery steel. Our latest locomotives are equipped with two bars placed side by side.

For some years we have been making drawbars of ½-in. tank steel. The plates are cut the right width to leave plenty of stock around the hole, the center is cut down to 5 in. with the acetylene torch and sheer. Enough plates are used to make the bar the right thickness and a "U"-shaped yoke of 1-in. round iron is placed around the center, with a piece of 1-in. by 2-in. iron clamped across it, double nutted and screwed down tight. The drawbar is then sent to the machine shop to have the holes drilled.

This makes a good flexible bar and so far we have had no failures. When it is necessary to shorten them, the yoke is taken off and each leaf is shortened and put together again. Very little slack is allowed on the Bangor & Aroostook; if there is ⅛ in. slack, it has to be taken up.

Discussion

Some of the speakers reported that it was the practice on their roads to use scrap car axles for this purpose. It was generally agreed, however, that the carbon content of the steel in car axles was too high to make satisfactory drawbars.

The problem of reclaiming drawbars having worn holes led to some discussion as to the advisability of this practice. Some roads make a practice of upsetting the drawbar on a die that extends up the side of the head in order to prevent the hole from being flattened during the upsetting process. Other roads make it a practice to build up the hole with oxy-acetylene welding. It was contended, however, that the heat evolved in the welding process tended to crystallize the metal and thus weaken the drawbar. It seemed to be the concensus of opinion that it was poor practice to weld a liner inside the hole.

Frame repairing

By P. T. Lavinder

Blacksmith foreman, Norfolk & Western

We formerly used the electric welding process exclusively in repairing broken locomotive frames, with the exception of the smith shop forge welds. The electric welding process has been replaced by the oxy-acetylene when welding frames in position on the locomotive. When a frame is removed from the locomotive and welding is necessary, we recommend that it be forge welded in the smith shop.

The following is a complete record of the results obtained on the Norfolk & Western during the past 17 months by the various welding processes.

Kind of weld	No. welds made	No. welds failed	Per cent failure
Oxy-acetylene	757	28	3.7
Smith shop forge	12	0	0
Electric	58	14	24
Total	827	42	5

In making oxy-acetylene welds on locomotive frames we proceed as follows:

1—Remove all parts necessary to provide expansion and to allow free access to both sides of the frame.

2—Make sure the frame is in line and properly blocked so that it will stay in perfect alinement during welding.

3—Tram the frame, using a one-piece tram and have the tram marks, if possible, not closer than 12 in. to the break.

4—Vee out the frame at 45 deg. angles all the way through, from both sides, using the oxy-acetylene cutting process.

5—Spread the frame for expansion, allowing ¼ in. to ⅜ in. according to the size of the frame.

6—The scarfs of the vee must be chipped or brought to a red heat and cleaned with the welding torch to remove all burnt metal before starting the weld.

7—Use a plate under all vertical welds; the plate should stand away from the frame ⅛-in. to allow perfect fusion at the bottom of the weld. When the weld is completed remove the plate and finish smoothly on the bottom with a welding torch.

8—When a weld is broken always cut out all the old weld and make a new weld on good sound metal.

9—If this makes a gap over 2-in. in the center of the vee, cut out a section of the frame not shorter than 6 in. and weld in a new piece.

10—In some locations a new section is welded in where old welds have been made, or where flaws are found.

11—On frames 5 in. by 6 in., or larger, a preheating furnace is used and a charcoal or coke fire is carried around the frame at the point of the weld during the welding. When the weld is completed the furnace is removed and the weld is wrapped with asbestos to permit slow cooling.

12—On smaller frames, the frame is wrapped with asbestos for a distance of 12 in. on each side of the weld to hold the heat during the operation. When the weld is finished, it is wrapped with asbestos to permit slow cooling.

13—When a weld is started it must be continued and never allowed to cool down until finished and must be welded from both sides at the same time.

14—All welds are reinforced not less than 20 per cent when clearance will permit.

15—The spreader is generally removed immediately after completing the weld, but good judgment must be used in this matter as there is sometimes danger of upsetting if the spreader is removed too soon.

16—Successful frame welding will depend upon two main factors; namely, proper preparation and competent welders.

We attach a record plate to all frame welds showing the engine number, name of the welder, kind of weld, place and date welded. The plate is numbered showing the number of times the frame has been welded in the

same location. A report is then made to the office of the superintendent of motive power, giving the same information, and in case a weld fails, the record plate is removed and sent to the office of the superintendent of motive power, thus making it possible to keep a complete record of all frame welding.

Reclamation

By Walter Constance

Blacksmith foreman, Chesapeake & Ohio, Barboursville, W. Va.

The Chesapeake & Ohio has no large central shop for reclamation. Most of the articles are usually reclaimed in the general shops. Brake beams are repaired at six different points. Couplers are straightened, truck sides and body bolsters are repaired, all-steel car parts and even steel center sills are reclaimed, for the most part, at the large central shops at Huntington, W. Va. All track tools for the entire system are brought to Huntington by the supply train. Special dies for Bradley hammers are used to make chisels, spike mauls and picks. All tamping ends for tamping picks are upset upon 2½-in. Ajax forging machines. We can make from 1,000 to 1,200 tamping ends in eight hours, using one forging machine man and one additional smith to do the work of hardening. In cases where the tamping picks are too short to upset, they are made into clay picks, one end being built up by welding where necessary.

Tire steel is used to make blacksmith tools and some kinds of draft keys. Electric welding saves much of the material around the shops that formerly was scrapped.

Discussion

The reclamation of scrap car axles was discussed by a large number of those present. It is practiced to a limited extent by a number of roads throughout the country, but only one railroad shop, located in the middle west, seems to have taken up this work extensively. All of the work for reclaiming car axles for the entire system is centralized at this shop. During the past ten years some 30,000 scrap axles have been returned to service at the annual saving estimated at $40,000. Worn axles are returned to service as a standard axle of the next smaller standard size.

The scrapped axles are placed in a furnace and heated for half their length. When the axle reaches the desired heat, it is swung to a 4,000-lb. double-frame steam hammer on a jib crane. The end collar or "button" is drawn down to size by three or four blows in the smaller groove of the hammer die and the wheel seat collar is drawn down to the size of the wheel seat in the larger groove. The axle is then returned to the furnace, the other half is heated and the above operations repeated.

If the axle is slightly bent, it is straightened and the length between the fillets at the inside of the journal is gaged for correct length. If the axle is too short, it is drawn slightly at either side of the center so as to restore it to the required length. After the end collars have been upset and all forging work completed, the axle is annealed, allowed to cool overnight and is then forwarded to the lathe department for turning.

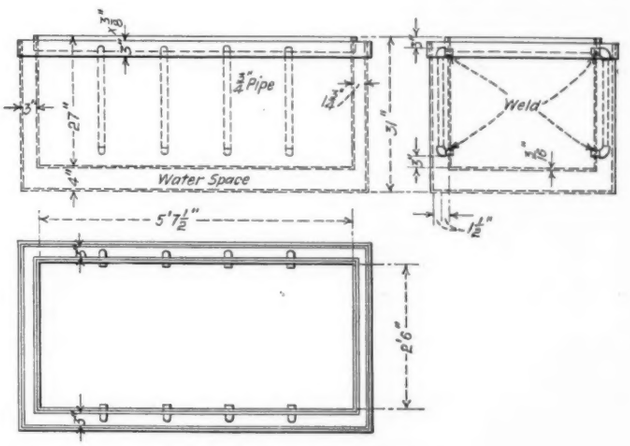
Spring making and repairing

By Geo. H. Corcoran

Blacksmith foreman, Grand Trunk, Battle Creek, Mich.

Springs received from outside points have the bands removed. All broken and worn leaves are replaced with new steel, the springs are tested and returned to service. Springs removed from locomotives in the shop for repairs are sent to the spring department where they are inspected and if found defective are repaired. Springs found to be all right have the proper height and carrying test load stencilled on them and are then returned to service. Spring leaves are heated in a fuel oil furnace to 1600 deg. F., formed on a Ryerson leaf forming machine and cooled in a tank of Houghton's Soluble No. 2 quenching oil. They remain in this oil until cooled down to 900 deg. F., or what is called a flash temper, and this leaf is used in the forming machine for bending the next leaf in shape.

The oil tank is placed in a larger tank which is surrounded by running water. It is equipped with 8¾-in. pipes, four on each side of the tank. These pipes run out from the side of the oil tank, about 2 in. from the top and down through the water and again into the oil tank near the bottom. When a hot leaf is placed in the oil, the hot oil comes to the top, flows out into the side



Spring tempering vat

pipes, down and into the tank at the bottom. By this time the oil is cold and it automatically feeds back into the tank and never requires any attention. We have tested the oil for several weeks and the temperature was found to be between normal and 130 deg. F., which was the highest in eight hours of constant use.

The spring plant is equipped with a hydraulic spring bander, hydraulic spring band remover, combination punch and shear, spring tapering rolls, nibbler and trimmer, a pneumatic spring tester and three furnaces for heating and tempering spring leaves. All the spring leaves are painted with heavy oil and graphite before banding. Some of our spring bands are forged and welded and some are of cast steel which costs about one cent per pound less than we can forge them. We have had bood success with them. Weldless bands are used for tender and coach springs.

The writer recently visited one of the largest production spring plants in the world, which specialized on a certain class of springs. Spring leaves are fed in one end of a furnace and come out the other end, heated to 1500 deg. F. They are then placed in a spring forming machine which revolves in a large vat of quenching oil. The forming machine has four or five arms. As a hot plate is put in the machine, it clamps it to a form and is held fast to the shape while the machine revolves in the oil and cools it off. Each leaf in the spring has a special machine form and oil tank. All leaves are made at the same time so that there is no fitting of the spring plates as all leaves are a perfect fit. After the leaves are hardened, they are placed in a nitrate of soda bath and heated to 900 deg. F. and held at that temperature for 15 minutes and then taken out.

All spring steel received at this plant is tested by

metallurgists before any is unloaded out of cars. Special machinery is constantly in use for testing completed springs for load endurance and breaking point and records are kept of these data. Brindell tests are made and a hardness of from 387 to 418 is required.

There is no doubt but that a great change is about due in railroad shops for making springs in a more scientific way. A few roads are making them that way now, but not many. Most of us are depending on our spring makers and while we are fortunate in having good spring makers, we do have to rely on their good judgment for getting good springs and we know that what they do has a certain "chance" element. When we have the equipment to make a spring scientifically, step by step, then we will feel that we have made a spring that can be depended upon. While we know that some scientifically made springs do break, they are a thousand times more reliable than when made by "chance."

Proper heat treatment is an important part of spring making. Accuracy in the proper degree of heat for hardening and drawing back is vital to the life of a spring. Electric furnaces are most accurate for controlling the temperature as they will keep within five degrees of any desired heat, thus making it possible to give every leaf in the spring the same heat treatment. It is not so with oil because of lack of uniformity. One tank of oil will be heavy, another light or medium. One oil will burn clear and free, another dead and smoky. With these and varying degrees of heat, it is impossible to keep a furnace at a fixed temperature in order to obtain constant results.

Vanadium spring steel will also probably come into more general use. It was tried out some years ago on a number of railroads but it did not make any better spring than the carbon spring steel. Today with a better understanding of the right heat treatment, there is no doubt but that it will make a much lighter and better spring than the carbon spring steel.

Welding in railroad shop practice

Equipment and methods used in Santa Fe shops at Albuquerque, N. M., insure dependable work

WELDING practices employed in the Santa Fe shops at Albuquerque, N. M., are probably as good a representation of best railroad practice as can be found. The shops were built about two years ago and accordingly the equipment used is for the most part new. On the other hand two years have elapsed since it was installed and in this time means have been devised for using the equipment to best advantage.

The shops include roundhouse, car shop and back shop.

A pile of truck side frames, truck bolsters and body bolsters reclaimed by welding

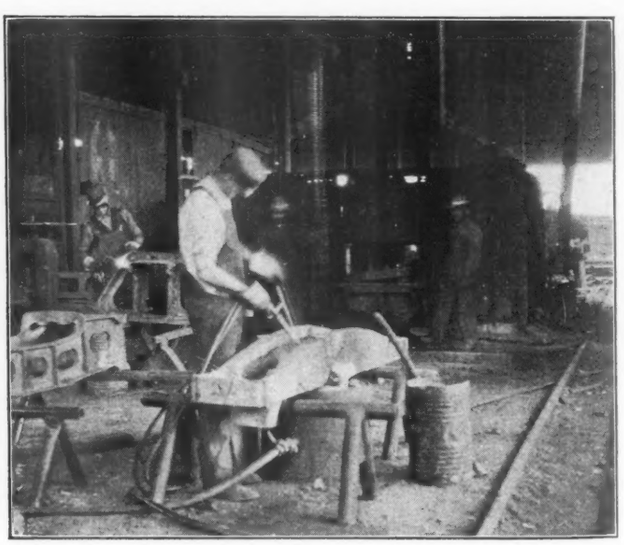
The back shop is now turning out something over 300 classified repairs a year and normal annual output of the car shop is 1,200 heavy car repairs.

Equipment

Both the gas and electric process are used, the gas being used for welding and cutting, the electric for welding only. The electric arc welding equipment consists of six portable electric welding machines in back shop, two in roundhouse and one stationary type in welding shop, which furnishes current for four operators.

The flue welding shop is equipped with one small and one large electric flash or butt welding machine, the small machine being used for safe ending flues from two inch to two and one-quarter inch diameter; the large machine is used for all flues of larger sizes.

There are also two portable electric arc welding machines in use at the car department for welding of car castings.



Welding shop in the car department, showing the preheating forge, horses for supporting the castings and the annealing furnace

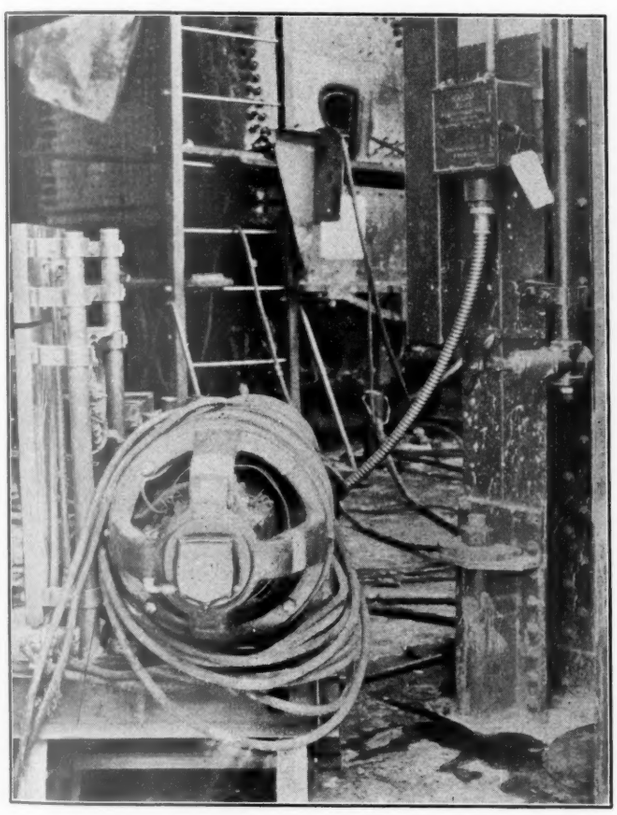
All car repair work is done in the car shop or yard. Small locomotive parts that can be moved easily are taken to the welding repair shop and the welding of large parts is done in the back shop.

The car shop, roundhouse and back shop are piped for both acetylene and oxygen. The acetylene is carried at a pressure of from 7 to 8 oz. in a 4-in. line with smaller

laterals. A 2-in. line and a pressure of 55 lb. is used for the oxygen. The oxygen is purchased in cylinders. A number of cylinders, connected through a manifold, supply oxygen to the pipe line. Practically all of the acetylene is generated in a small generating plant in the shop and supplied to the pipe line from this plant. A few cylinders of acetylene are kept on hand for use on a portable outfit that can be taken to outlying points.

In the locomotive department there are about 200 gas stations or outlets and there are 87 on the repair tracks and in the car shed. On the erecting floor the gas stations are located in the pits and on the machine side they are placed on the columns. The welding and cutting torches are fitted with 50-ft. hoses.

The electric welding sets are operating from a 230-volt direct current circuit in the back shop and roundhouse and from a 440-volt, 3 phase alternating current circuit in the car shop. On the erecting and machine tool floors



One of the portable arc welders in service

the welding outlets are located on the columns about 6 ft. above the floor. The receptacles have an interlocking mechanism so arranged that the plug cannot be inserted or removed from the receptacle unless the switch is open. These outlets are also used for the operation of portable lathes and motor driven cylinder boring bars.

The motor of each welding set is provided with a six foot lead or armored cable and a plug for connecting to the power supply outlets. The lead is made short so that the set must be close to the column when it is connected and cannot be set so as to obstruct the aisles. The generators are provided with cambric insulated, braid covered welding leads from 50 to 70 feet long.

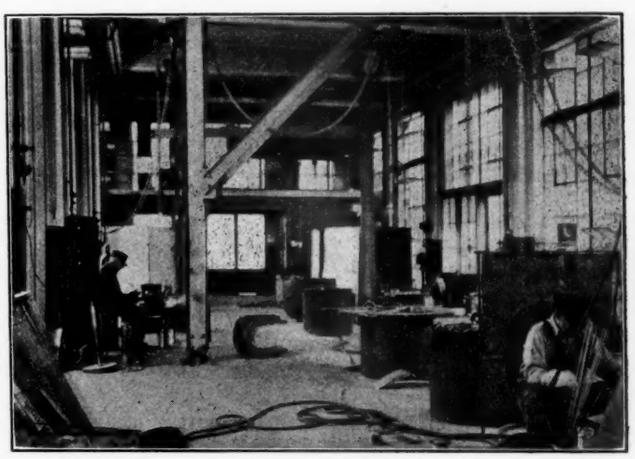
Car department welding

Welding has been applied to the work of the car department on a large scale with surprising results. The bulk of the work done consists of welding cracked truck side frames, truck bolsters and body bolsters in accordance with A. R. A. rule 23.

The sections to be welded are first inspected to determine whether or not the fractures are within the welding limits. Before a weld is made the piece is cleaned with a sand blast. The crack is V'd out with the cutting torch and the slag chiped off with a cold chisel and hammer. The weld is then made either with the electric arc or the gas welding torch.

When the torch is used, the member to be welded is placed over a pre-heating forge with the ends of the section on horses. The horses were built by the welding process from 3-in. pipe. The forge is made of a piece of 24-in. pipe about 20 in. long. About 6 in. from the lower end there is a circular grate with a piece of ¼ in. pipe projecting through the center. The pipe is supplied with air from the shop air line and the amount of blast is regulated by a valve just outside the forge. The forge burns coke and is used to heat the part of the casting on which the weld is made. This procedure has been found to improve the character of the weld and to reduce the amount of gas required to make the weld.

After the weld is made the casting is picked up by a 1½-ton chain hoist on a post crane and placed in an an-



The welding shop

nealing furnace. The furnace has a capacity of four castings and burns oil. The castings are heated to a temperature of from 1,400 to 1,500 deg. F. after which they are removed and allowed to cool. They are then given a final inspection and replaced in service. All truck side frames and bolsters which are welded are marked to show the shop in which the weld was made, the operator who did the work and the date the work was done. Thus AQ-6-3-5-25 would signify that the work has been done at Albuquerque by welder No. 6 on the fifth of March, 1925.

The normal output of the car shop is about 100 cars per month. The savings effected by welding in this department alone, not considering scrap value, have been shown to be $6,000 a month. The welding is done by 5 gas and 2 electric operators.

Locomotive department welding

The work done by the locomotive department has so many ramifications that it would be difficult just to make a list of the jobs done. For this reason only a few of the outstanding or unusual jobs are mentioned here.

The method of applying shields to superheater units or tubes, is one operation, which has proven to be highly

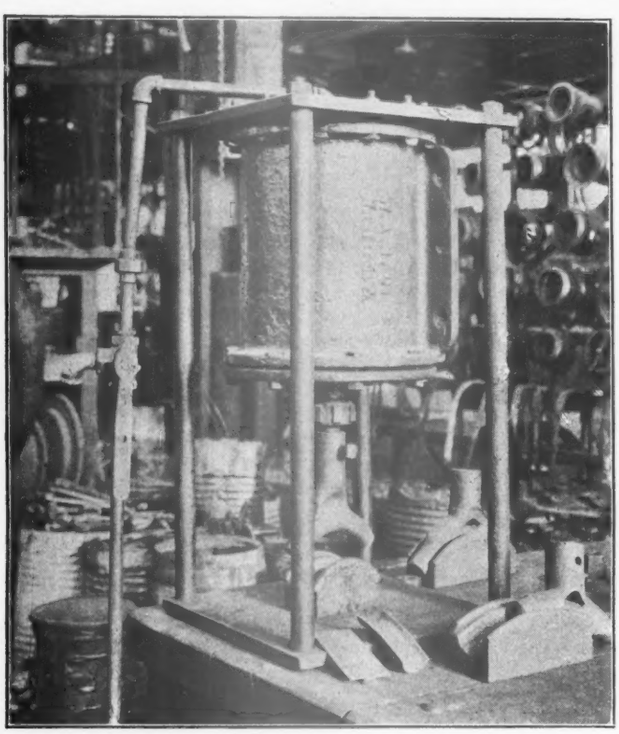
profitable. There are two places in the curved-up ends of the tubes where they are cut by cinders. To prevent damage from this source a piece of No. 14 or No. 16 steel plate is formed so as to fit the outside of the tube, and is placed over the section that is subjected to wear. It is held in position by four tack welds at the corners. The protecting plates are formed in a die, operated by an air cylinder.

The feed and elevator screws on stokers when worn by the action of the coal are built up by either the gas or electric process. After the edge of the screw has been built up it is left rough as welded. The welded edge is sufficiently accurate for the purpose and the surface of the weld withstands the action of the coal effectively. Stoker rack teeth are replaced with electric welding and machined after welding.

These and many others can be cited as examples of the importance of welding in the locomotive department.

Welding shop

Portable locomotive parts which require welding are taken to the welding shop. It is housed in a one-story building, 30 ft. wide by 90 ft. long. There are ten gas stations in the building and four electric welding outlets. Current for electric welding is supplied by a four-operator stationary welder mounted on a platform or balcony at one end of the shop. Polarized battery charging re-



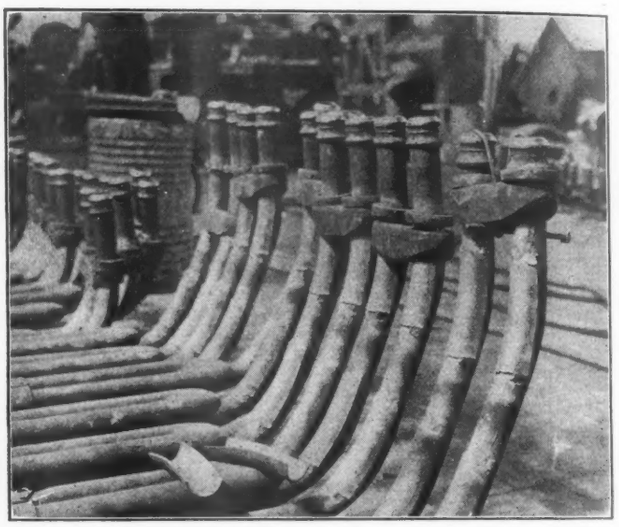
Press and dies for forming superheater reinforcing plates

ceptacles are used as welding outlets and 50 ft. welding leads and shop-made electrode holders are used.

The shop is also equipped with three-coke-burning, preheating furnaces, two 1½-ton and two 3-ton air operated jib hoists, six welding tables, a heavy vise, a cutting table and an exhaust hood for brass welding. The welding tables are 22-in. high and have legs made of 3-in. pipe. Originally the tops of these tables were covered with fire brick, but a piece of ¾ in. boiler plate was found to be a more satisfactory top and a piece has been laid on top of the brick on each table. The cutting table consists of a large iron kettle across the top of which have been placed several pieces of scrap boiler plate so as to form a sort of grill on which the material is cut.

Testing operators

In order that officials in charge of welding and the welders themselves may know what kind of welding is being done from month to month, it is the practice of the Santa Fe Railway to have each welder furnish a test plate monthly. The manner in which this plate is made and tested was described recently in a paper by E. E. Chapmen, engineer of tests and H. H. Service, supervisor of welding equipment, presented before the Chicago section



Some reinforced superheater units

of the American Welding Society. The procedure is as follows:

Secure two pieces of boiler steel ⅜ x 2½ x 9 in., bevel one end of each to form a 90 deg. angle between them, place the two plates in a convenient position for welding with 3/16 in. opening at the bottom of the "V" and make the weld from the top side only, reinforced a maximum of 20 per cent over stock size on one side only, if welder desires this much reinforcement to produce his best weld.

It will be noted that in this test plate the weld is allowed to be reinforced 20 per cent over stock size, more than that is milled or ground off, and plate to be welded only from one side, in order that the welder can approximate the condition of welding a side sheet or its equivalent in a firebox. The welder is instructed not to forward any weld for test unless he is satisfied that it is the best he can make, and representative of the work he does. These welders are then rated according to the percentage strength of their welds which is based on the thickness of the original stock, and an ultimate strength of 60,000 lb. per square inch. It is the desire to have welders stimulate actual working conditions as nearly as possible, and it is also endeavored by the foreman to have the welder complete his work at the original heat and avoid the plastering over of metal incident to reworking and consequent weakening of the original weld. From the test data thus obtained the foreman has sufficient information at hand to judge the welder's ability to produce good work and it will justify him taking proper steps for keeping the welding up to a high standard by correcting the faults or assigning only the men who are able to make satisfactory welds to the more important welding operations.

Tests have also been made to determine the relative efficiency of welded specimens to the original stock, under vibration or alternate bending, but this is a comparative

proposition and not one that can be used as a regular control.

Welding efficiency

An analysis was made of specimens tested for the years 1920 and 1921 to show the average efficiency of welds produced by welders having different years of welding service and the results are shown in Table I.

TABLE I

Years service as welder	Welded specimens tested		*Efficiency of weld—per cent	
	Gas	Electric	Gas	Electric
Less than one	195	147	75.8	90.6
One	93	81	89.2	93.2
Two	177	131	85.8	92.9
Three	78	72	84.4	95.2
Four	47	10	90.6	96.9
Five	27	..	96.7	....
Six	4	6	98.3	101.0
Seven	3	9	74.6	94.9
Eight	16	..	82.4	....
Nine	7	..	89.6	....
Total	647	456	Ave. 86.7	95.0

* These efficiences are values based on a tensile strength of 52,000 lb. per sq. in., the minimum value allotted in specifications for firebox steel.

It is noted that for the seven and eight years welding service the value showed a great deal below the average which was due to a poor welder working in these two groups, but the indications are that the longer the service the greater the skill shown by operators. It will also be noted from this tabulation that for strength alone the electric welding shows up better than the oxyacetylene welding. However, for the year 1923, a check of this relation shows that due to improvement of the kind of metal used for welding with oxyacetylene the results of the latter are about on a par with the electric welding for strength.

The results obtained in four of the largest shops and in four of the largest roundhouses of the system are shown for the last three months of the year, October, November and December, 1924, in Table II.

TABLE II

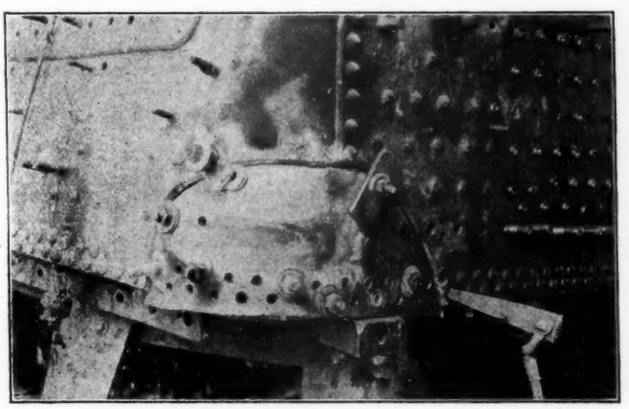
Shops	Welded specimens number tested		*Specimens broken outside of weld, per cent		†Efficiency, per cent specimens broken in weld			
					Gas		Electric	
	Gas	Elec.	Gas	Elec.	Min.	Ave.	Min.	Ave.
Topeka	29	46	24	24	77	101	75	96
Albuquerque	63	32	62	53	57	99	75	101
San Bernardino	31	34	45	38	84	104	88	104
Cleburne	16	9	63	33	68	90	83	98
Total	139	121	..	..	..	..	..	..
Minimum	..	..	..	..	57	..	75	..
Average	..	..	50	37	..	98	..	99
Roundhouses								
Winslow	9	9	56	33	101	108	98	105
Amarillo	8	8	75	75	103	103	78	89
Newton	22	32	46	22	80	99	88	100
Shopton	25	22	52	36	83	98	79	103
Total	64	71	..	..	..	..	..	..
Minimum	..	..	..	..	80	..	78	..
Average	..	..	53	34	..	100	..	101

*This column also includes welds which showed 60,000 lb. per sq. in. tensile strength.
†Efficiency based on firebox steel, 52,000 lb. per sq. in. minimum tensile strength.

It will be seen from these figures that a butt welded seam with a maximum reinforcement of 20 per cent of stock averages well above the 45 or 50 per cent efficiency allowed for single riveted seams.

It is believed that for a large railway system like the Santa Fe too much stress cannot be laid on demanding of welders that they produce the proper strength of welds as shown by their test specimens so that both the management and the welders may know when they are doing acceptable work. The test pieces are returned to originating shops and the results discussed with the individual men by the foreman in charge. The system supervisor of welding equipment and service company representatives also go over the results of weld tests with the men and make suggestions for the betterment of the service.

From this it will be seen that the railway management exercises a systematic control over autogenous welding operations, especially as it concerns the welding of boiler and tank steel plates. This, of course, is only one phase of the rather extensive use of these welding methods and the periodic control can easily be exercised, but there is a very extensive amount of work where such control cannot be so applied. Problems, such as best procedure and method of welding locomotive frames, bolsters, couplers, cylinders, where heating and subsequent annealing are required, and many similar questions require careful service observations or comparative tests. The question arrives as to whether it is practical to weld certain kinds of material, whether hot or cold, whether to use cast iron or steel rods for welding material, and with such questions raised many tests have been conducted to increase the list of "Dont's" for anything not prohibited is assumed to be permissible.



A sample of welding in the boiler shop, showing the method used for grounding one side of the electric welding circuit

Material used

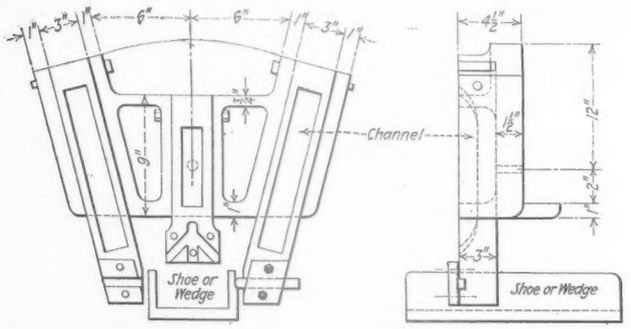
Norway iron welding rods are used for plugging holes and building up worn castings and steel rods are used for all work requiring high tensile strength. Steel electrodes are used for welding fire boxes, building up spots on locomotive frames and all steel castings, etc. Steel electrodes are also used for fire box work flues and for welding broken locomotive frames. Pure iron electrodes are used for flues and flexible stay bolt sleeves, etc. Tobin bronze is used for air pumps, and some cylinder work, but is not always used for repairing broken cast iron castings. Manganese bronze is used for building up rod brasses, galled places on main rods and worn spots on cross heads. Work that cannot be machined is ground down and finished with grinders.

Welding instructions

Data on new classes of work have been carefully compiled by the supervisor of welding equipment and in compliance with instructions from J. Purcell, assistant to the vice president in charge of mechanical matters, these data were issued as a standard pamphlet, designated "Oxyacetylene and Electric Arc Welding Folio," for the instruction and guidance of those who have direct supervision of welding in the various shops and roundhouses on the system. This welding folio is kept up to date by frequent revisions and as better methods are devised and better welding materials are developed, and tried out with satisfactory results, they are included in the folio.

Tool for planing shoes and wedges

A PLANER tool for finishing shoes and wedges on four sides in one operation is shown in the drawing. This tool was developed in the Finley shops, Birmingham, Ala., of the Southern Railway. It consists essentially of a back plate provided with three tool holders, pivoted as shown in the drawing. The shoes or wedges are ganged end to end the entire length of the planer platen. The cutting tools are held in place by means of

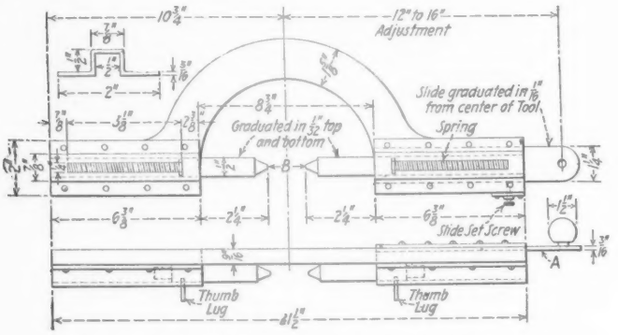


Planer tool for finishing shoes or wedges on four sides in one operation

clamps on the tool holders. They can be easily adjusted by partly loosening the clamp bolts and moving them toward or away from the work as desired. The back plate serves as a support for the cutting tool holders on the forward stroke, while on the return stroke, the tool holders are free to swing outwards on the pivot bolts. The center tool holder is constructed to hold three cutting tools so that both the inside faces and bottom can be planed at the same time.

Crank pin throw gage

THE throw of worn crank pins can be quickly and easily checked by the use of the gage shown in the drawing, as fast as they appear in the back shop for repairs. The ball center is attached to a graduated steel slide *A* which can be set for any desired crank pin throw. The 1/16-in. graduation marks of this slide are deter-



Gage for checking the throw of worn crank pins

mined by measuring from the center of the gage or from the center line equidistant from the points *B*. The points *B* are also on graduated steel slides which, when set, determine the exact condition of the throw of the pin.

For instance, if the crank pin throw should be 14 in., the ball center *A* is set to 14 in. The ball center is now placed in the axle center and the gage swung around until the points *B* are against the crank pin. If both of the point slides *B* read the same, it is known that the throw is correct.

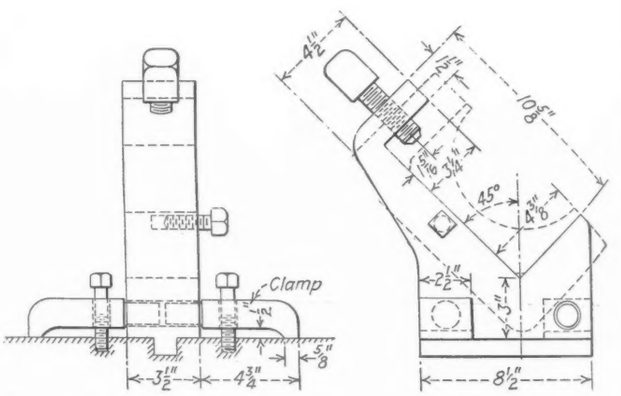
It has been found in the shops where this gage is in use that by frequent checking of the wheel quarters and pin throw, as well as careful tramming of the wheel centers from one another, troubles from broken side rods have been practically eliminated.

Milling grease grooves in main rod brasses

By E. A. Miller

THE drawings show a tool and jig for milling grease grooves in main rod brasses. This tool and jig have been adopted as standard on a large eastern railroad.

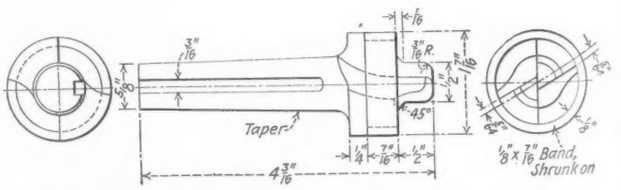
The shank of the tool is made with a standard taper.



Jig for holding main rod brasses on the shaper table when milling grease grooves

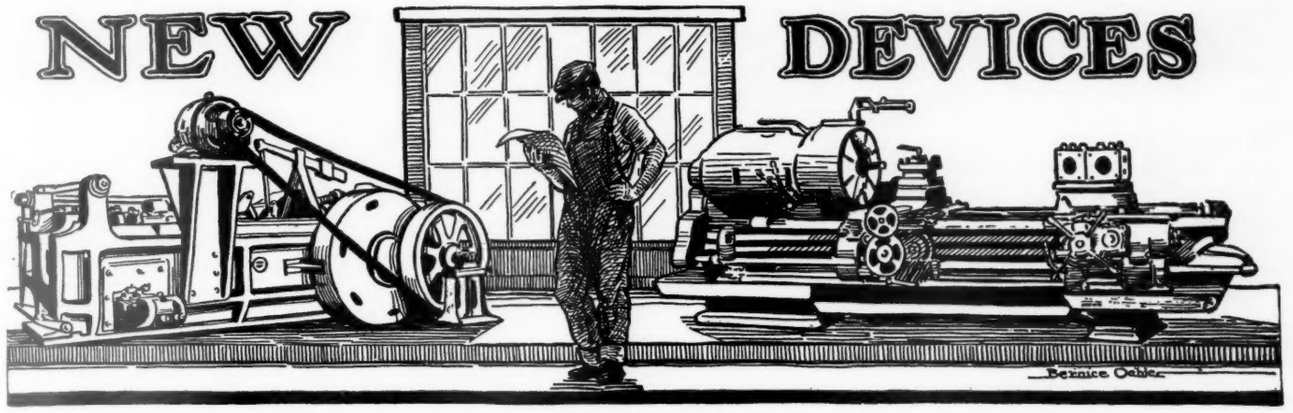
The cutters and shank are formed from one piece. A 1/8 in. by 7/16 in. band is shrunk into an offset on the head so as to provide a guiding edge for the operator to judge the depth of the groove. It also serves to reinforce the edges of the cutter. This band can be removed and narrowed down as the cutters become shorter from repeated grindings.

The jig for holding the main rod brass to the machine



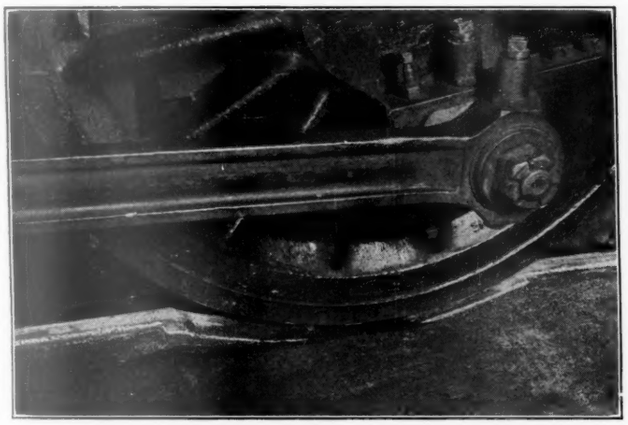
Tool for milling grease grooves in main rod brasses

table can be machined from a solid piece of wrought steel 3½ in. thick. It is clamped to the table as shown in the left hand view of the drawing. The main rod brass is clamped in the jig by means of a set screw. This arrangement facilitates the setting up and removal of the work in a short time.



Spring track assists in enginehouse work

THE Cardwell spring track has been developed recently by the Globe Railway Equipment Company, St. Louis, Mo., primarily to save time and labor in the enginehouse work. It operates on the well-known principle of the depressed track and consists of two steel rail castings, each five feet long and having a depression 3½ in. deep.

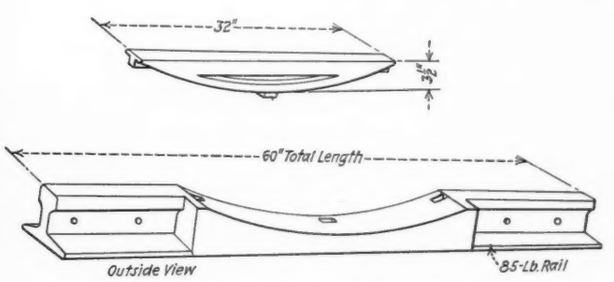


Right main wheel in the depression ready for the application of blocking over the driving box

The depression, shown in the drawing, consists of 32 in. of the circumference of a circle 10 ft. in diameter. The rail castings are inserted in one or more of the tracks inside the enginehouse.

Under normal conditions the depressions are closed by application of the removable segments which are held in alinement with the rail by lugs fitting in corresponding holes in the track castings. When necessary to perform such operations as changing engine truck wheels, shimming tires, renewing driving or trailer springs, etc., the removable segments are taken out. By blocking under the required parts of the spring rigging and running one pair of wheels into the depression, the weight can be taken off that particular pair of wheels without the labor and time involved in jacking up the locomotive, as would otherwise be necessary.

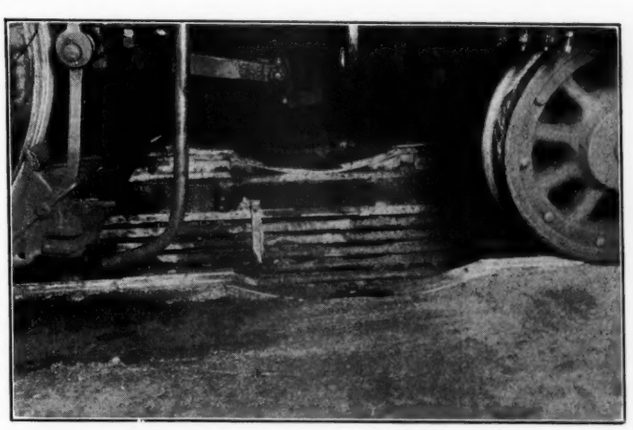
The Cardwell spring track has been in operation for several months and has proved to be entirely practicable. The provision of more than one spring track in the enginehouse, possibly one for every five or six stalls, will have a tendency to prevent delays to locomotives while a single spring track is occupied. The best location for the device is back of the driving wheel drop pit or engine truck drop pit, and, on all other tracks, far enough inside



A Cardwell spring track section

the house to accommodate the trailer wheels and still permit the enginehouse doors to be closed.

The following description of several operations using the Cardwell spring track will indicate the variety of work which can be performed with it: In renewing driving or



Removable segments can now be put in place and the track used like any section of level track

trailer springs, blocks are placed between the equalizers and locomotive frame or safety hangers in such a way that when the particular pair of wheels involved is run into the depression, the weight is removed from the driv-

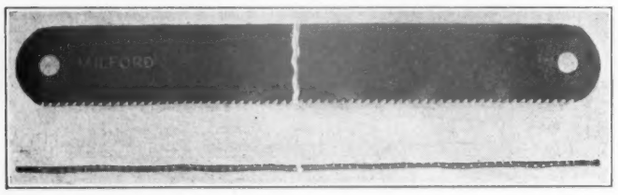
ing box or trailer housing, as the case may be. The new spring is then applied and the locomotive moved so as to pull the wheels out of the depression, the spring change thus being accomplished without any jacking up.

In cases where engine truck drop pits are not available the spring track can be used for changing either or both pairs of wheels in a four-wheel engine truck. The method of procedure in this case is to take down the truck pedestals in question and chain up the engine truck frame. The front driving wheels are then run into the depression and blocking applied between the front driving boxes and the locomotive frames. Movement of the locomotive wheels out of the depression raises the front of the engine and the front truck frame so that the defective truck wheels can be rolled out and others applied. The locomotive front end is lowered and the weight put back on the engine truck by the reverse operation.

In addition to facilitating all classes of spring work and changing engine truck wheels, trailer or engine truck brasses may be changed by means of the spring track. The effect of the device is to save nearly one-third of the time and labor involved in jacking up locomotives when necessary for one reason or another to remove the weight from various parts of the spring rigging.

Improved power hack saw blade

A POWER hack saw blade known as the wavy-set has recently been placed on the market by the Henry G. Thompson & Son Company, New Haven, Conn. The trade name has been derived from the method of setting the teeth in the blades. This method is intended to give additional strength to the teeth and to make them more nearly alike in shape. It is said, with this form of setting, that it is quite practicable to use a 10-pitch blade on thin-walled tubing.



Notice the wavy appearance of the cutting teeth of the Milford hack saw blade

The characteristic setting of the teeth is accomplished by passing the heated blades through a series of suitably shaped rollers that bend the serrated edge first in one direction and then another, imparting to the edge a wavy appearance not unlike that of a thin circular milling cutter. The waving extends away from the edge far enough so that each tooth is assured the support of the full thickness of the stock, and the abrupt bend caused by the usual method of setting is avoided, which is a desirable feature.

Overhead mounted wood swing saw

A SWING cut-off saw which may be mounted either on a wall or ceiling, designed for safety, lightness and ease of operation, has recently been placed on the market by the Oliver Machinery Company, Grand Rapids, Mich.

The hanger bracket is cast in one piece with a 37-in. base, machined parallel to the trunnion axis of the swinging arm. It is so designed that the machine may be mounted either on the wall or ceiling without any fitting other than placing the weight arm in the proper position. The main frame is of the rigid, single arm type, cored in a U-form. It swings on ground pins of large diameter. The counterbalance is so constructed as to give the operation of the arm an easy and lively motion. It acts on the arm at a point about one-third of the way down from the trunnions. In this location, it takes less weight to throw the arm back to the starting position and a lesser effort for the operator to throw it forward. The slot in the weight arm is shaped to bring the saw to its starting position.

The motor arbor housing is tongued and grooved to the frame with a 2-in. vertical adjustment allowed for setting up or to provide for a 4-in. reduction in the size of the saw. The housing is of a three piece rigid construction, with the end pieces of cast aluminum. The stator of the motor is mounted in the housing. The shaftless rotor is mounted on and keyed to the saw arbor. The motor has a full load speed of 3,450 r.p.m. and may be furnished up to 5 hp. for two or three phase, 60 cycles, 220 or 440 volts. The saw arbor is mounted in two radial ball bearings which run in grease and are encased to prevent dirt from coming in contact with them. The arbor carries two 4-in. diameter saw collars, a nut and a 16-in. saw blade.

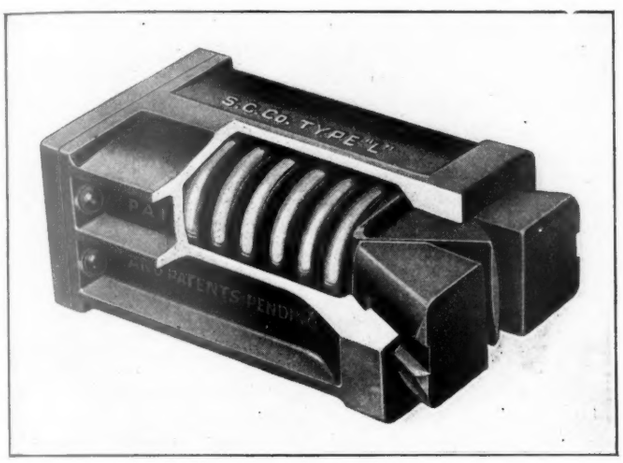
The machine is covered with a one piece cast guard over the top and sides with a hinged steel plate on one

The motor of the Oliver swing saw is mounted on the arbor head

side which can readily be lifted back in order to change the saw blade. The machine is lubricated by means of the Alemite system. When furnished with an 18-in. saw, it will cut planks 12 in. wide and 3½ in. thick. It is approximately 7 ft. 6 in. from center of saw to base of ceiling hanger.

High capacity draft gear

TWO fundamental conditions have vitally affected the efficiency in service of all draft gears. On the one hand there has been the continued trend toward the use of larger and heavier cars, more powerful locomotives and longer trains. On the other hand there is the continued inflexibility of standard overall dimensions within which, for purposes of interchangeability, the draft gear is required to fit and function. Accepting these conditions as the most desirable ground work on which to build, the Sessions-Standard Type L friction draft gear manufactured by the Standard Coupler Company, New York, has been designed for the purpose of combining the following characteristics: High capacity, increasing progressively and uniformly with the gear travel; ample recoil; sturdiness and oversolid strength; 2½-in. travel, all friction; substantial initial compression, both spring and friction; only five parts; electric steel housing.



The Sessions-Standard draft gear designed to give a substantial initial compression and high absorption of energy

Using a tup of 9,000 lb. falling 2 ft. ½ in., an average capacity of 18,375 ft. lb. is obtained. The average absorption of energy is approximately 75 per cent. Thus, the recoil is ample to insure a positive and prompt restoration of the friction elements to the working position and, correspondingly, to insure against sticking.

The 2½-in. of travel is all friction and the gear capacity is progressively uniform up to the closing point. Hence, the frequently encountered situation of an ostensibly high performance in gear capacity, actually accomplished in the last fraction of an inch of travel, is avoided and, as a consequence, sill and other structual stresses are kept well below the danger limits instead of being compelled to suffer the bad effects of an inefficient shock absorbing mechanism.

The provision of initial spring compression definitely retards to the maximum degree the accumulation of slack and enables the user to secure full friction travel and a long continuation of high capacity rating.

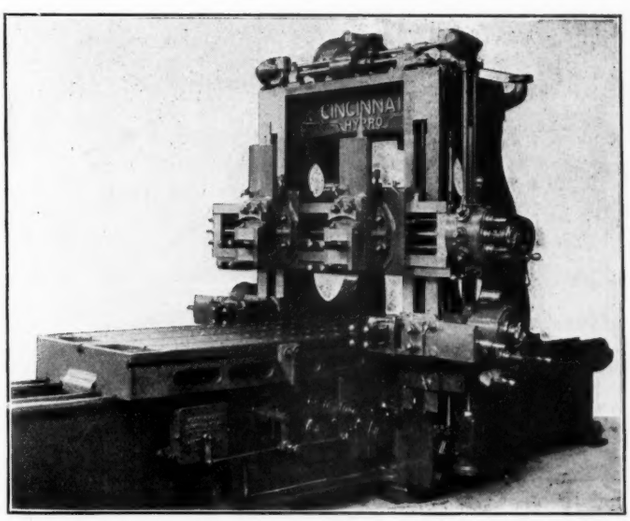
Planer designed for production work

CONVENIENCE for the operator and simplicity of design, elimination of delicate wearing parts, and fool-proof arrangement to eliminate liability of breakages is claimed for the construction of the dial feeding mechanism, rail lift and rapid power traverse to the heads of a planer recently placed on the market by the Cincinnati Planer Company, Cincinnati, Ohio.

All the heads are furnished with selective dial feeds which are graduated to 1/64 in. and arranged so that any feed up to one inch can be instantly set from the operator's position and read from the front of the machine. The rail and side head each have a separate feed with a safety feature so that they can be fed into each other without causing any breakage.

A single turn rail clamping device is used, operating through a crank handle at the end of the cross rail—one turn of this crank clamps the rail securely to the inside face of the housing. The rail clamping mechanism automatically engages the elevating gear when the rail is released and again breaks this connection when it is clamped, making it impossible to engage the elevating mechanism while the rail is clamped. Automatic stops limit the maximum travel of the rail.

The rapid power traverse is so arranged that by one movement either one or both rail heads may be moved across the rail and the tool moves up or down at the same time. Any one of these movements can also be secured independently and instantly, the whole being operated and reversed through one lever. Both side heads are provided with rapid traverse independent of the rail heads. A



Operating levers and points of lubrication conveniently located on Cincinnati planer

slip clutch is used so that no damage results if any one of the heads are run together or beyond their limit. All the control levers are centrally located.

The housings are designed not only with wide faces but so that the heavy thrust of the side head tools is taken by a square section through metal to metal contact. To further increase rigidity at maximum height, the housings are tied together at the top by a full depth box arch, giving balance to the entire machine.

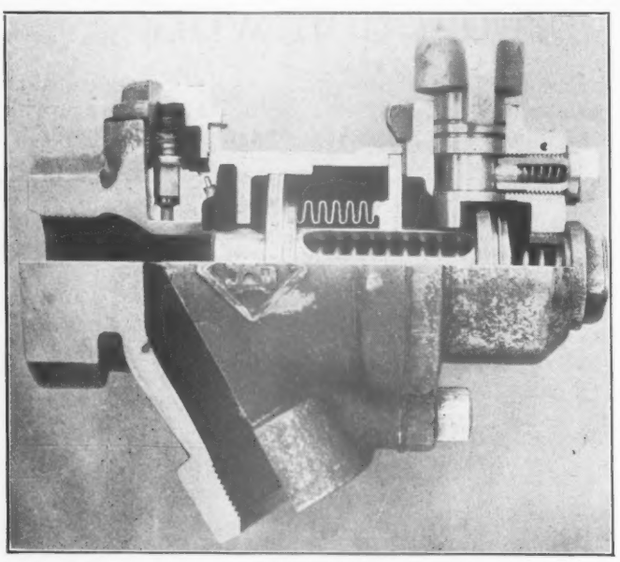
All the slides have the dove tail inverted, resulting in a much heavier cross section through the center. This type of design causes the dove tail bearings to become tighter under pressure. Taper gibs are used throughout on sliding surfaces. Herringbone gears are used throughout the machine.

Continuous lubrication of all moving parts has been given special attention. A pump located in the bed takes oil from the tank through a strainer, then passes it through a filter. Oil is forced into the vees near the center of the bed and distributed through channels the full length of the table so that the table constantly rides on a film of oil. An abundance of oil is always present on short and long strokes. The overflow forms a head or volume in the vees in the front of the table, flushing out any small particles of dirt into the strainer at the end of the bed, thus washing them clean at each stroke of the planer. All the gears in the bed revolve with their shafts which in turn revolve in ground bearings. Filtered oil is flowing constantly to the large chambers surrounding the main bearings, keeping them filled. Before this oil reaches the running bearing it is again filtered by passing through felt wicks. A steady stream of filtered oil is sprayed over all of the running gears. This method keeps the gears above the oil pan and prevents disturbing the sediment which, in time, forms at the bottom of the pan.

The old time oil cup or oilers have been displaced entirely by the use of centralized oil distributors which require filling only once in ten days. One of these distributors has been placed on each side head, on the elevating mechanism, at the end of the rail and one on each of the rail heads. This latter not only lubricates the revolving bearings but also all sliding surfaces. Since this oil reaches the sliding surfaces in the center it tends to keep out any dirt and insures a much longer life to parts that usually receive scant attention, if any oil at all. Proper lubrication is essential to any machine.

Semi-automatic angle cock

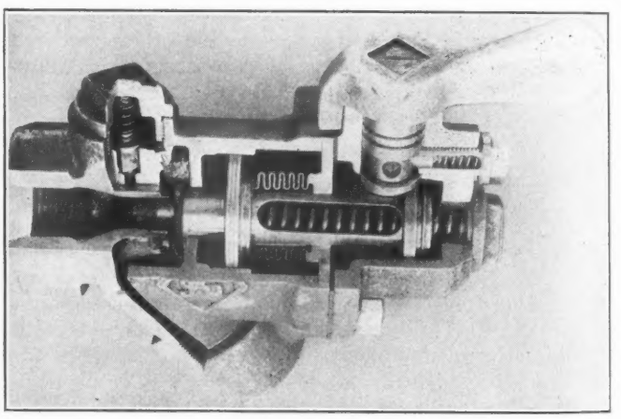
IN order to eliminate the potential danger of serious accidents due to the loss of braking power caused by accidental or malicious closing of angle cocks and yet maintain the present flexibility of the air brake system, a semi-automatic angle cock incorporating new principles has been designed by engineers and associates of the Sprague Safety Control & Signal Corporation, New York. This valve is so constructed that it will automatically maintain an open brake-pipe passage so long as the hose couplings between the cars are connected, irrespective of any accidental or malicious movement of the handle, and will also operate to close this passage automatically when



View showing the angle cock in the closed position

the cars are uncoupled, provided that the operating handle has been placed in the "off" position. It is interchangeable with the present cone valve and is manipulated in precisely the same manner. It may be mixed indiscriminately with older equipment and no changes in procedure will be required in making up train or switching cars.

In the illustration showing the valve in the closed position, it will be seen that the mechanism consists of a cylinder casting threaded at the left hand end for attachment to the brake pipe and at the lower point for attachment of



The angle cock in the open position

the flexible hose coupling. The interior of the casting is divided by an interval baffle plate with a central aperture through which projects an axial extension of the main piston; the face of the axial extension is provided with a rubber valve seat which registers with a bronze valve bushing on the end of the Venturi reduction in the air passage.

When in the "off" position with the hose coupling disconnected, flow of air past this valve seat is prevented by the pressure of the helical seating spring, shown in the sectionalized axial spring guide on the right of the piston. Brazed to the right side of the piston and to the left side of a holding guide plate is a sylphon or flexible metallic bellows. The operation of this bellows is similar to that of a flexible diaphragm except that on account of its form a much longer stroke is permissible.

With the locomotive coupled to a train and all the hose

connections made, the valve handles are turned to the position parallel to the line of the brake pipe in which they are automatically maintained by means of a ball lock. During this movement of the angle cock handle, the valve and operating piston are lifted by the opening cam against the thrust of the seating spring, and as a consequence, brake pipe air flows through the system. The handles of the rear and of the pilot angle cocks of the brake pipe are as at present left in the closed position.

Once the spring-pressed valve is lifted from its seat by means of the opening cam, brake pipe air will flow through the hose connections. This pressure will act on the face of the piston and force the valve to the extreme open position. This pressure will also gradually equalize by the piston and fill the annular space on the outside of the sylphon bellows, but the entire interior of the sylphon is maintained at atmospheric pressure. As a result an unbalanced force of sufficient moment is created by the differential air pressures to overcome the thrust of the seating spring. The piston valve will thus remain in the open or right-hand position so long as the hose couplings are made and any appreciable air remains in the system. If the angle cock handle should be moved to the "off" position accidentally or maliciously, it can not affect the piston valve as the cam is single acting toward the "on" position. Full service and emergency brake applications may be made at will through any number of angle cocks with the handle in the "off" or "closed" position.

When uncoupling cars all that is necessary is to place the handles of both angle cocks in "closed" or "off" position and part the hose. Pressure in the hose will reduce practically instantaneously to atmosphere; the slight amount of air coming through the Venturi reduction strikes the baffle plate and, owing to its peculiar form, reduces the pressure between the baffle plate and the piston to or below atmospheric by means of an ejector action. The pressure momentary trapped in the annular space to the right of the piston and the exterior of the sylphon acts as a powerful momentarily supplement to the spring, and forces the valve to its seat. The action just described is so rapid that the brake pipe air loss is hardly perceptible on a pressure gage. Once the valve has been seated, after parting of the hose, it is maintained in the closed position by the helical spring.

This semi-automatic angle cock will operate without adjustment over all ranges of brake pipe pressure from 70 lb. to 110 lb. and consequently, it is equally suitable for freight or for passenger service.

Vertical and horizontal reaming machine

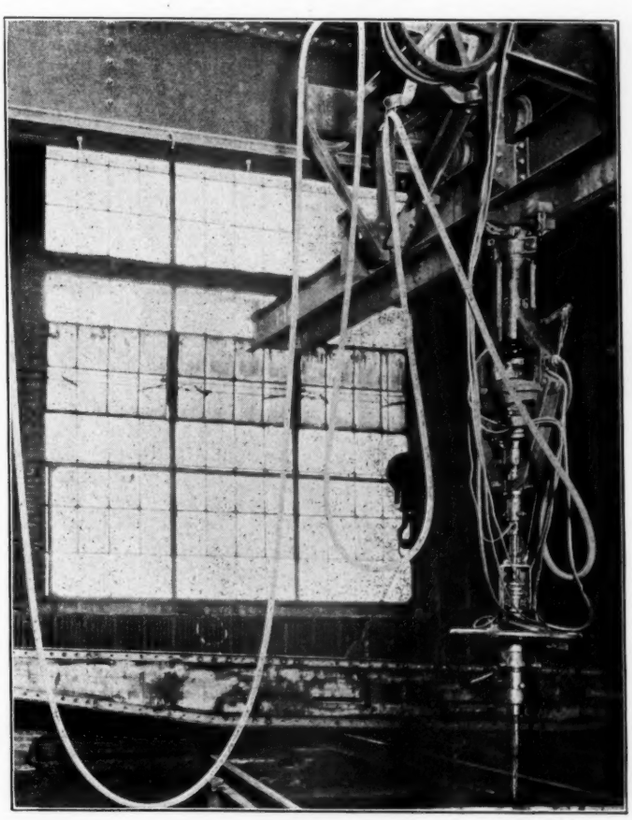
THE American Car & Foundry Company, New York, has recently placed on the market a vertical and horizontal reaming machine developed and used as standard equipment at all the plants of this company.

The machine is controlled by a single operator, who becomes skilled in its use in 10 hours or less, and can then accurately ream holes as fast as he can find them. Mounted on a traveler which can be racked forward or backward by means of an electric motor controlled by a switch located on the hand-wheel, the longitudinal spacing of holes is limited only by the length of the traveler runway. The trolley which carries the machine has been built with ball-bearings, so that a very light push on the hand-wheel will give horizontal control along the traveler bridge; here again the width of the work islimited only by the length of the traveler bridge.

The electric motor used for rotating the reamer bit has a break-test capacity of 6.9 hp., and will ream holes up to 1⅝ in. in diameter. Rotation of the armature is controlled by a contactor, which is operated automatically when the air cylinder, used for vertical control, is lowered or raised. The air valve used for controlling the air cylinder is operated by means of a clamp handle, located on the hand-wheel. A safety clutch is placed between the reamer bit and rotating armature shaft extension. This clutch is released as soon as the operator's hands are removed from the hand-wheel; and, when released, the reamer bit immediately stops rotating. Since the bit, and its extension if used, are the only exposed rotating parts, this clutch insures safety.

The machine has sufficient weight and rigidity to insure vertical reaming, and yet has a certain amount of flexibility, permitting the bit to enter holes not in the proper alinement.

Maintenance consists principally in the occasional renewal of motor brushes and lubrication. All parts are interchangeable, so that any part can be readily duplicated and all parts are readily accessible to inspection and repair. Breakage of reamer bits is practically eliminated, because the weight of the machine has been accurately determined as sufficient to drive the reamer through the hole without applying additional external force, and because of accurate central withdrawal from the hole by means of the air cylinder. Reamer bits can be changed as conveniently as a drill in any standard machine.

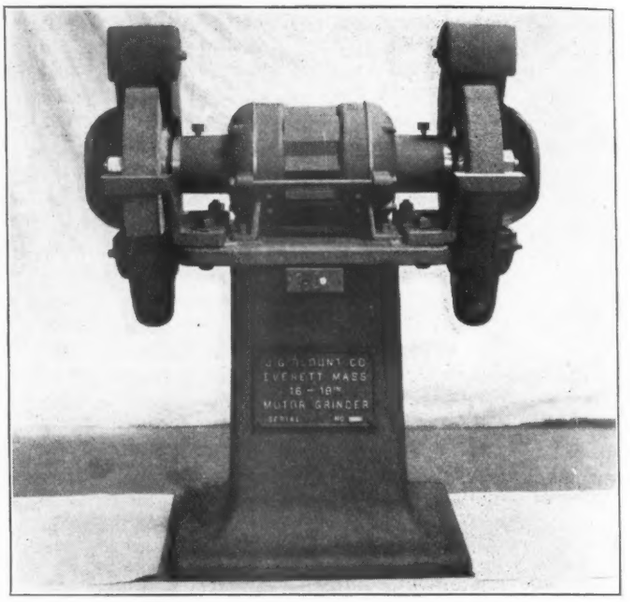


The weight of this machine feeds the reamer in holes up to 1⅝ in. without any exertion on the part of the operator

Ball bearing motor grinder

A 5-HP. ball bearing motor grinder designed for general heavy grinding work has recently been placed on the market by the J. G. Blount Company, Everett, Mass. It is fully equipped with large ball bearings of the deep groove type. The spindle is of carbon steel, turned, ground and threaded, thus insuring a perfect fit in the bearings.

The machine is driven by a Westinghouse 5-hp., 40 deg. rated motor operated at 1,200 r.p.m. It is controlled by a start and stop push button conveniently located on the under side of the pan directly in front of the grinder which is used in conjunction with an automatic starter. The motor end shields are of cast iron, turned with a recess and bolted directly to the motor frame. These shields are also secured in position by two longitudinal bolts at the rear and in front of the motor. The end shield flanges are turned and threaded into the ends of the motor end shields. The wheel flanges on the machine are recessed on the inside. The wheel guards are of the improved safety exhaust type which have a nosepiece and removable covers which increase the sides of the wheel flange and nut for safety protection. Rest supports are adjustable to various positions. The grinder and wheels weigh approximately 1,163 lb. It requires a minimum of floor space.



Double end grinder for general heavy grinding

A decarbonizer for locomotives

THE purpose of the Ehrhart decarbonizer manufactured by the Pilot Packing Company, Chicago, is to introduce a driving journal compound into the valve chest, to prevent an accumulation of carbon in the exhaust passages and eliminate existing carbon deposits.

A cylinder grease lubricator which has no moving parts

It is simple in construction as there are no moving parts or wearing surfaces. No changes or adjustments are needed as the size of the hole in the choke is standard. It is mounted directly on the main valve chest. The tapped holes now used by relief valves may be used if available or it may be connected to the stud at the oil pipe connection, by making the stud sufficiently heavy to support it, and bracing it from the smoke box. All connections should be steam-tight.

When in operation steam enters the body of the decarbonizer from the bottom through the small opening in the choke plugs, percolates through the grease which mixes with the steam and, with each movement of the main valve, a measured quantity of grease is drawn into the valve chamber, the quantity being controlled by the standard size opening in the choke plug. This, in connection with the hydrostatic lubricator, insures thorough lubrication of all surfaces within the valve chest and cylinder, under all conditions.

There are no valves between the decarbonizer and the steam chest. It is filled with new or reclaimed driving journal compound, the filling plug tightly secured and it is ready for operation. It requires no attention from the engine crew other than to know that it is filled regularly, as it works automatically and positively.

To fill the decarbonizer, the drain valve on the side of the decarbonizer is opened to remove any possible accumulation of steam, and then it is filled with grease and the drain valve closed.

The decarbonizer shown is the No. 2 medium size, holds 3 lb. of grease and will run 300 miles without refilling. Size No. 3 holds 1½ lb. of grease and will run from terminal to terminal without refilling.

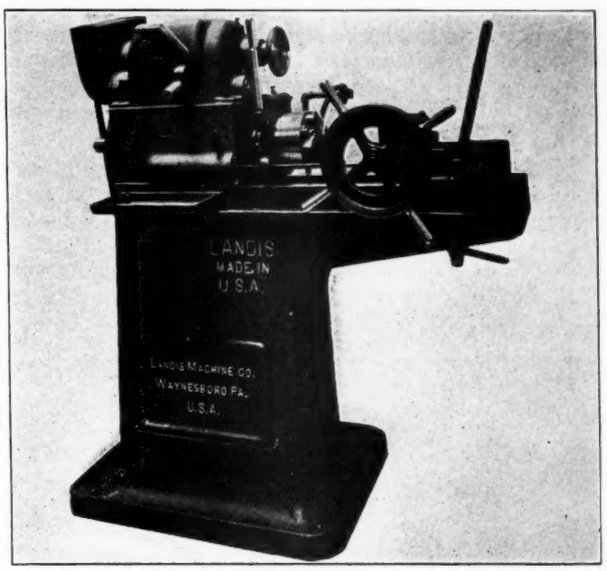
One-half inch single head threading machine

A NEW design of ½-in. single head threading machine has recently been placed on the market by the Landis Machine Company, Waynesboro, Pa. This machine has a geared headstock and a single pulley drive. The machine has four speeds, which give to the die head the following r.p.m.: 157, 226, 315 and 441.

The die head is opened and closed automatically by the carriage, or by hand at predetermined limits. The vise has a horizontal side-wise as well as a vertical centering adjustment. This feature insures a perfect and permanent alinement with the die.

A full supply of cooling lubricant is maintained at the die head by a rotary pump and there is a special control valve at the die head for shutting off the oil supply when necessary. The frame is cast in one piece with a fluid tight bottom. The driving pulley is mounted on top of the machine.

This machine is readily converted to motor drive. The power is transmitted from the motor shaft to the drive shaft of the machine by means of a belt. The motor is mounted on a plate placed on top of the headstock, so as to economize floor space, and to prevent dirt and oil from accumulating on the motor parts. The floor space occupied is 4 ft. 1½ in. by 1 ft. 11½ in. The net weight is 950 lb.

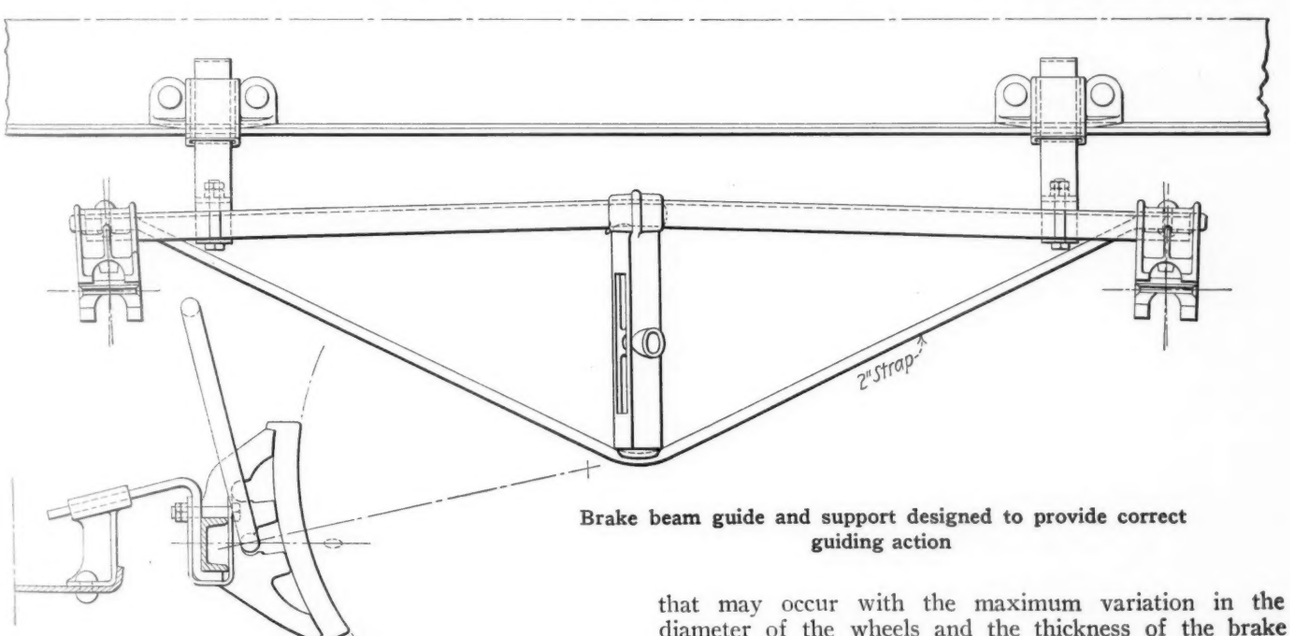


The die head is opened and closed automatically by the carriage, or by hand at predetermined limits

Huntoon brake beam guide and safety hanger

A BRAKE beam guide and support combining the advantages of simplicity, strength and superior guiding action has been introduced by The Bradford Corporation, New York. As shown in the drawing, this device consists of a guide casting riveted to the spring plank and an arm passing through the casting and bolted to the compression member of the brake beam with a bent clamp. Two of the guides are applied on each brake beam at any convenient location near the ends of the beams.

The guide arm is smaller than the slot in the casting and normally is in contact only on its upper surface. The angle of the arm and the slot is such that the brake shoe is held in proper alinement to insure even wear. Correct guiding action is afforded over the entire range of travel that may occur with the maximum variation in the diameter of the wheels and the thickness of the brake shoes.



Brake beam guide and support designed to provide correct guiding action

Because of the location and the construction of this guide, there is very little interference in case it is necessary to remove or replace brake beams. When the clamp bolt is removed the guide arm can be slipped through the

guide casting far enough to permit the brake beam to pass the projecting end.

One of the special features of this guide and support is the fact that it functions the same whether the frictional force applied to the brake shoe is upward or downward, and, therefore, will prevent brake beams from climbing the wheel as well as keep them from dropping. The point at which the guiding effect is exerted is a considerable distance from the hanger hole in the brake shoe and because of this condition, slight variations in the relative location of the members or the lengths of the hangers will not have any appreciable effect on the alinement of the brake shoe with respect to the wheel. The guide arm and guide casting are amply strong to withstand forces to which they are subjected in case the hanger fails to support the beam.

Heating unit of large capacity

CONSIDERABLE difficulty is often experienced in heating satisfactorily certain railway shops, or certain parts of the shop. The American Blower Company, Detroit, Mich., has recently placed on the market a self contained heating unit which is adaptable for use in such locations.

View showing general design and construction of a self contained indirect heating unit

The heating unit is light and compact. The steam tubes over which the air circulates are made of straight seamless copper and around each tube is wound a helical brass fin which increases the heat radiating surface. This fin is wound around the tubes in such a manner that much of its surface is in contact with the outer surface of the tube and this joint is later treated so that the fin and the tube become metallically integral, to facilitate the transmission of the heat from the tube to the fin.

In building these tubes into heating units, the method of assembly is simple and strong. The tubes are arranged in rows and the ends are pressed into a thin flexible copper plate, the holes in which are slightly smaller than the tubes. This gives tight flange connections which are later soldered. The flexibility of the plate takes care of expansion and contraction. Semi-cylindrical headers provided with steam connections are then placed over the ends of the tubes and locked on by means of a folded seam construction. Each unit includes a standard motor-driven fan.

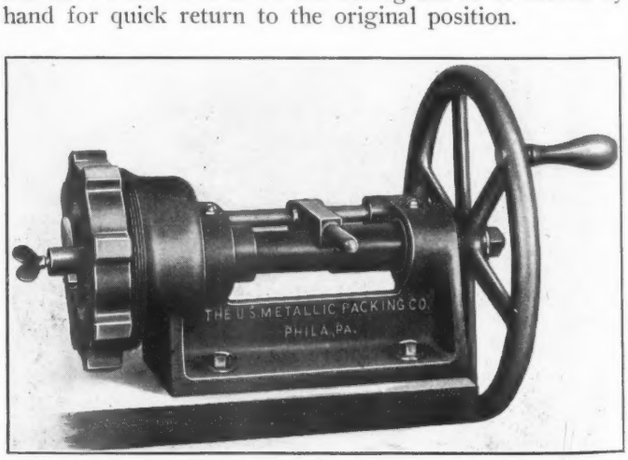
The heating unit shown in the illustration delivers approximately 650,000 B.t.u. an hour, with initial or room and final temperatures of 40 deg. and 111.3 deg., respectively. At initial and final temperatures of 70 and 128 deg., its capacity is approximately 500,000 B.t.u. an hour. The fan operates at 565 r.p.m., delivering 8,000 cu. ft. of air per min. These units can be combined in one assembly containing as many units as desired, depending on the size of the room to be heated.

Hand boring lathe for King packing

THE practice of sending packing rings from the enginehouse to the back shop for reboring is an inefficient and costly one. To facilitate this work the United States Metallic Packing Company, Philadelphia, Pa., has recently placed on the market a hand-operated lathe for boring out King metallic packing.

The lathe is composed of a body with the chuck cast integral. The chuck is machined to accommodate a 5-in. King packing ring and is adjusted to the various sizes of rings by means of reducing bushings. The boring bar is made in one piece with a ⅜-in. square high speed tool bit fitted in one end and which is held in place with a wing set screw. The opposite end of the boring bar is fitted with a large wheel which is rotated by hand by means of a handle that is free to turn on a small spindle. The boring bar revolves in bronze bushings forced in holes which are bored concentric with the chuck. This insures absolute concentricity of the ring.

In the center of the boring bar a reduced threaded portion is engaged by a half nut that gives the boring bar a longitudinal motion when the wheel is revolved. The half nut can be raised to allow the boring bar to be moved by hand for quick return to the original position.



Convenient machine for quickly machining King metallic packing

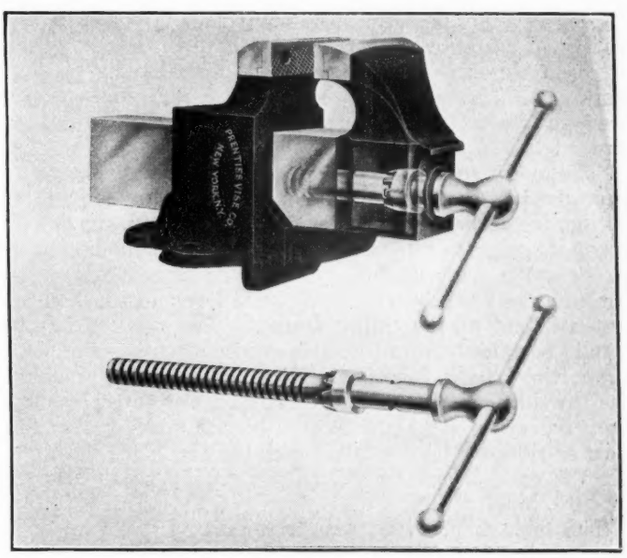
The packing ring is clamped in the chuck by means of a nut that has an internal thread which engages an external thread on the chuck. The nut is drawn up tightly by hand, which is sufficient to clamp the rings. The body of the lathe is drilled to accommodate four bolts or lag screws for fastening it to the end of a bench.

Improved vise screw collar

THE accompanying illustration shows a new collar fastening for vise screws which is a recent improvement made to the vises manufactured by the Prentiss Vise Cmpany, New York. The purpose of this collar is to fasten the screw to the front jaw and draw out this jaw when the screw to the front jaw is turned to open the vise. If the collar or any other device used for fastening the main screw to the front jaw becomes loose, there is lost motion which has to be taken up before the vise is opened or closed. The new collar does not depend on a set screw to hold it in its proper position.

When the screw heads are forged on the main screws, two depressions are also forged on opposite sides of the screw shank. A castellated collar having prongs of varying lengths with prongs of the same length opposite each other are slipped over the screw. Two of these prongs are driven into the depressions in the screw shank making the collar for all practical purposes an integral part of the screw. This arrangement makes it certain that the front jaw will always follow the screw without any noticeable play or lost motion.

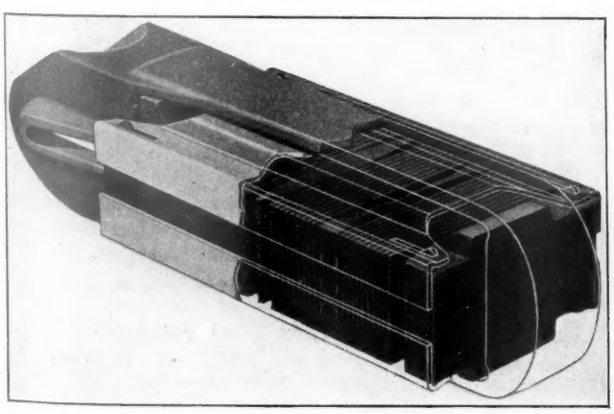
To minimize wear on these parts, all the bearing surfaces are machined. The collar itself is drilled to size to insure a close fit on the screw. Should any wear develop at these points through lack of lubrication and long use, a blow with a hammer on a flat punch placed against the prongs, will cause them to stretch and take up the wear. If this adjustment should not be sufficient, the depressed prongs can be cut off with a chisel and the collar turned around and a longer set of prongs driven in the depressions, thus holding it in a permanent position.



Prentiss vise screw collar designed to prevent lost motion

Improved draft gears for freight cars

THE illustration shows an enclosed type of draft gear made for capacities of 200,000 to 1,000,000 lb. and in standard sizes to fit 18½ in. and 24⅝ in. pockets, and in special sizes to suit special conditions.



Phantom view, showing the construction of the Waugh enclosed draft gear

There are over 4,000 sq. in. of frictional surfaces in addition to the spring capacity on a Standard 29⅛-in. draft gear. Its capacity is controlled by increasing or decreasing the number of plates in each group. This flexibility of design enables a railroad, if desired, to transfer the gear from one car to another and arrange the groups of plates to meet the capacity of the car.

In construction, the draft gear consists of straight spring plates, end followers with convex curved faces, spring end separators with concave curved faces and a convex center separator. The spring plates are oil tempered and the followers and separators are drop forgings and malleable castings.

In operation the groups of spring plates are deflected over the curved faces of the followers and separators which limit the deflection and protect the plates against injury from over solid blows.

The deflection of these plates from their normal straight form is attended by an increasing frictional adhesion of the surfaces, which adds to their cushion capacity and retards the recoil upon the return of the gear to normal position. When fully compressed, the plates in each group take a bearing over their entire area.

As the standard height of the spring plates and operating parts is 6 in., a bottom guide casting and a top guide pressing are used to retain the gear in approximately the vertical center of the standard 9¼ in. pocket and yoke. These guides also retain the gear in alinement regardless of variation in sill spacing. This draft gear is manufactured by the Waugh Equipment Company, Chicago.

High speed metal cut-off saw

THE machine illustrated below was designed by the Hunter Saw & Machine Company, Pittsburgh, Pa., to cut cold metal by means of a high rotative speed circular saw, particularly adapted for tubing and metal sections. The motor and saw blade are mounted on opposite ends of a tilting frame, the machine is driven by a belt from the motor and an idler pulley is located in the frame to give a maximum belt contact on the arbor pulley with a minimum tension. The saw arbor and idler pulley are equipped with S. K. F. self-alining ball bearings in oil-tight dust-proof housings. The belt and saw blades are fully protected by steel guards to conform with safety specifications. A pan is attached to the under side of the table enclosing the saw at its lowest point to catch cuttings. This pan can be dropped and the cuttings removed, which operation requires only a minimum of time.

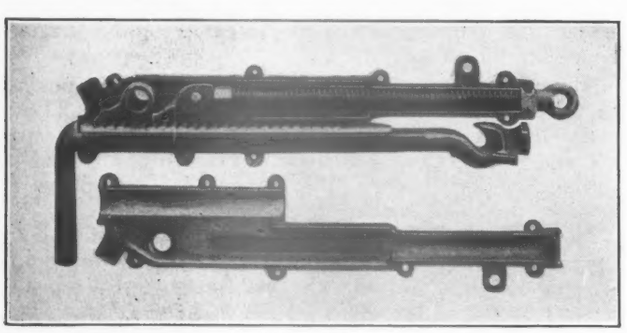
The motor support is provided with adjusting screws to give the belt the desired tension. The motor end of the tilting frame has a cushioned stop and is connected with a spiral spring to return the frame to the height necessary to clear the material being cut. The saw is fed down through the work by an offside hand lever attached to the forward end of the tilting frame. The work to be cut should be raised above the table on the clamping side with supporting strips furnished to prevent it from pinching the saw blade when passing through. For rapid production, the work should be located on the table so that the least section will be in contact with the saw blade throughout the cut. These conditions are readily obtained with this machine.

The table is provided with a graduated quadrant stop that can be set to any angle within the sweep of the saw blade used. This stop is held firmly in position on the table by a bolt moving through T-slots. The material is clamped by a quick-acting eccentric jaw. The machine has a capacity for tubes up to 4 in. in diameter. It is equipped to take care of a saw of 24-in. maximum overall section. It is driven by a 7½-hp. motor with a speed of 1,750 r.p.m. The machine occupies a floor space of 31 in. by 24 in. and can be readily moved if desired.

Hunter saw for cutting metal cold

Automatic slack adjuster for freight cars

WHILE the air brake today is one of the most highly developed and efficient devices used on freight cars, every part from the brake shoes to the brake cylinders must be in accurate adjustment for smooth and efficient braking of the long trains in use today. Varying slack on the different cars in the train caused by wear of brake shoes and wheels and the pins and holes in the brake rigging result in different piston travel and irregular braking action throughout the train. This irregular braking action is the principal cause of break-in-twos and damage to cars and lading caused by rough handling.

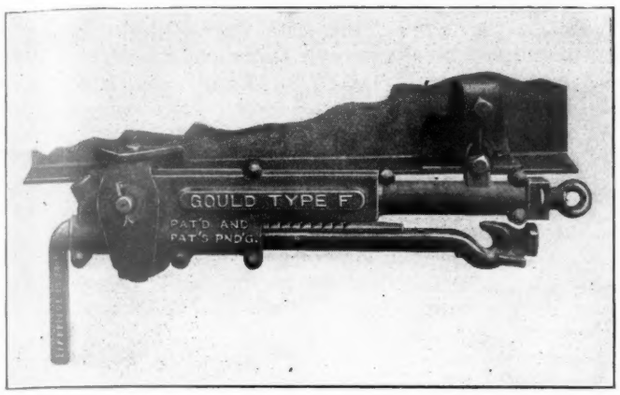


The contained parts of the Gould automatic brake slack adjuster

The Gould Coupler Company, New York, has spent a number of years in the development of a simple and efficient device for freight equipment and The Symington Company, Rochester, N. Y., now presents the result of this study and development in the Type F freight slack adjuster.

This adjuster automatically takes up wear in shoes, wheels, pins, etc., keeping the piston travel within approximately ½ in. of normal from the application of new shoes until they are worn out. When replacement of one or more shoes is necessary, the adjuster may be manually set back for this purpose, and upon the next application of the air, the device is automatically brought into proper adjustment. It is not necessary for the maintenance gang to make any calculations to determine the correct setting of the device as it is not possible to set it improperly.

This adjuster takes the place of the usual dead lever stop. It is attached to the bottom flange of one center sill by two forged brackets designed to allow the necessary flexibility so that the adjuster will accommodate itself to all normal movement of the dead lever on straight and curved track.



A slack adjuster for freight cars which takes the place of usual dead lever stop

The adjuster consists of a malleable iron housing which serves as a guide for a cylindrical holding rod, the latter being flexibly connected to the dead lever. This holding rod is itself held in position by a sliding rack strip which in turn is held by a pawl or dog. Mounted in the casing above the holding rod is an adjusting rod having a dog or pawl also engaging the holding rod rack strip and held in its normal position by the spring which encircles the adjusting rod. Attached to the eye at the rear of the adjusting rod is a connection which passes under the body bolster and is slidably attached to the top connection or pull rod of the brake rigging just beyond the live lever. An adjustable stop clamped to the top connection or pull rod actuates the adjusting rod as soon as any wear has developed or as soon as the cylinder push rod moves more than the predetermined amount. Assuming wear to have taken place, an application of the brakes moves the adjusting rod so that the movable pawl picks up one tooth on the holding rod rack strip. On the release of the brakes the spring returns the adjusting rod to its normal position carrying the holding rod with it and the holding rod is maintained in its new position by its engaging pawl. This operation is repeated as soon as additional wear amounts to the equivalent of one tooth space on the ratchet. In effect, the device is a dead lever stop with a large number of adjusting holes which automatically changes the position of the dead lever pin until the shoes are worn out.

Portable sanding machine for car repair work

THE usual method of finishing metal parts used on passenger cars is by hand filing and buffing. The Carborundum Company, Niagara Falls, N. Y., have placed on the market a portable sanding machine which takes the place of the hand method of finishing. This machine grinds away the metal with a special flexible abrasive disc driven by a motor through a flexible shaft. The disc is coated with Aloxite grains, a hard, sharp and tough abrasive or grinding material manufactured by the Carborundum Company.

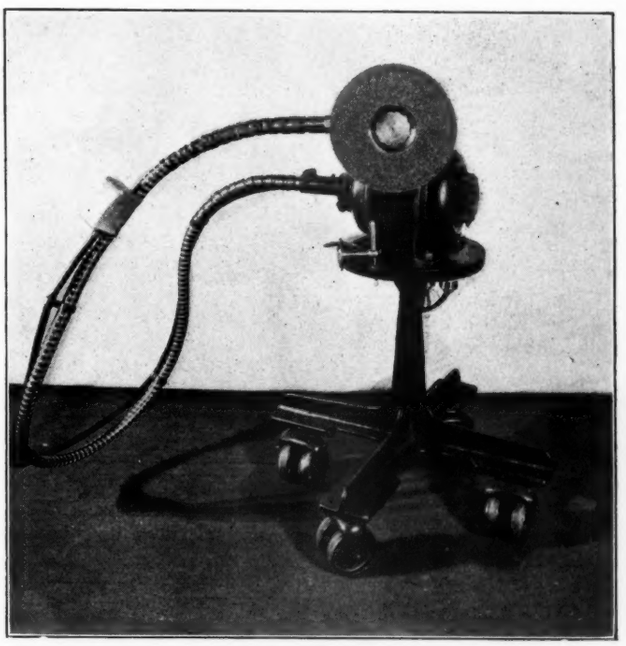
The motor is mounted on a rigid cast iron pedestal, 24 in. high supporting a swivel table providing for a swing of the motor half way around, or an arc of 180 deg. This feature adds greatly to the adaptability of the unit to any required position during the continuous grinding operations. The pedestal is supported by four substantial double castors, permitting ease of movement and travel, without danger of upsetting. A holder mounted on the table provides a secure resting place for the machine head when not in use.

Each machine is equipped with a one-horsepower motor built to such specifications as may be required to meet the power conditions of the user. The flexible shaft which drives the grinder head is of the most modern and approved type, especially adapted to meet heavy duty conditions. The main castings of the grinding head are of aluminum to insure lightness plus requisite strength and durability.

The assembly shafts and spindles are of steel, supported in ball bearings, reducing friction to a minimum. Heat treated, specially tempered steel mitre gears running in an oil-tight chamber packed with grease provide the angular drive from the flexible shaft. Ample facilities are arranged for the proper lubrication of all moving parts.

The grinding head is designed to be perfectly balanced and the driving mechanism is so planned and constructed as to eliminate vibration. The head is provided with two handles which are located to insure accurate control and convenience in operation.

The Aloxite grains with which the discs are coated



Flexibility of control and operation are features of the carborundum portable sanding machine

are uniformly graded and are coated on the discs in such a way as to allow for a free cutting action. There is a definite clearance between the grains so that every grain

has full cutting capacity. The grains are coated on a strong, durable backing of cloth drills. This cloth-backed disc is then securely fixed to a special fibre board disc with a moulded, counter-sunk center provided with six pin holes which locate over the pins in the special lock nut that holds the disc securely to the head. These discs are furnished in a standard size of 9¼ in. in diameter.

Flexibility is another important feature in connection with the discs and the grinding head. Evenly supporting the disc is a flexible and compressible pad which yields to the slightest pressure, thus conforming to work projections. This feature together with the flexibility of the discs itself permits the disc to conform readily to mouldings, beadings, sharp curves and contours, even under light pressure.

Portable acetylene generator

A SMALL generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxweld Acetylene Company, New York City. The generator, which takes 35 lb. of carbide at one

Oxweld portable, low pressure, acetylene generator

charge, can be transported readily from place to place, thus providing a portable supply of generated acetylene gas. When empty, the generator weighs only 210 lb.

A new principle of feed control is used which might be called a "heavier-than-water" float. A vertical partition, extending nearly to the bottom into a water seal, divides the generator shell. One side is gas tight and contains the carbide hopper at the top. The upper part of the other side contains gas regulating and protective devices, and an automatic carbide feed control. Generation of the first acetylene causes water to rise on this side of the partition high enough to all but submerge a pan full of water, hung to a control lever. This pan normally acts as a weight acting counter to a spring, but as the water rises about it, its apparent weight is diminished and the carbide hopper valve is closed by the action of the spring. As acetylene is drawn off, water rises in the gas compartment and correspondingly lowers under the float. This relieves some of the buoyancy under the water pan, which, gathering weight with the receding water, depresses the spring and allows a small amount of carbide to drop into the generator.

Because of its low center of gravity, the generator rights itself when tilted at an angle of 30 deg. It works perfectly at an inclination of upwards of 10 deg. No adverse effects result if a generator, while in operation, is knocked over. Nearly all fittings are enclosed in the cylindrical shell and there is little, if anything, projecting which may be injured by a fall on a concrete pavement.

Ohio universal and tool grinder

A NO. 2-L universal and tool grinder intended primarily for use in railroad and automobile shops for grinding reamers, boring bars, taps and similar tools, has been developed by the Oesterlein Machine Company, Cincinnati, Ohio. The machine will take work up to 30 in. between centers and has a 9-in. swing with a 7½-in. ver-

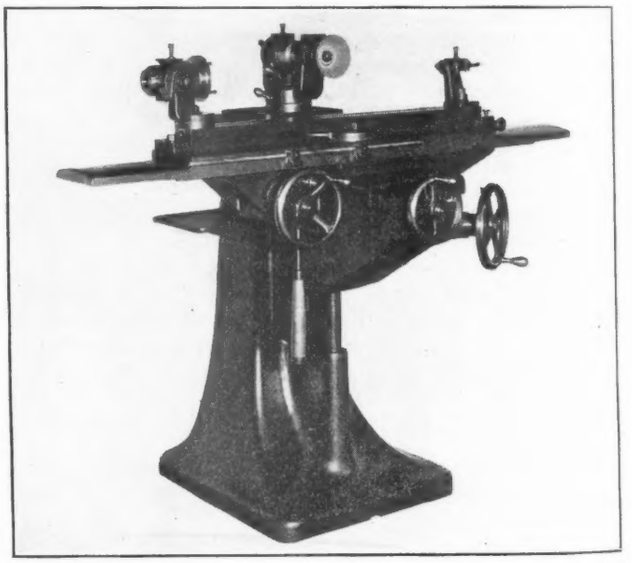


Table of the Oesterlein tool grinder may be reciprocated by means of a ball-bearing lever feed

tical movement. It is of the milling machine type of construction.

The table reciprocation may be obtained through a handwheel, in which case two gear ratios are available. In addition, a ball-bearing lever feed is provided that may be engaged at any point to permit the operator to use either his right or left hand for reciprocating the table. This lever feed has also been added to the Nos. 2 and 3 grinders built by this company.

General News

As a part of its expense-reduction program, the Pennsylvania has ordered the abandonment of the heavy repair shop on the Marion division at Logansport, Ind. A large number of the 800 men affected by this order have been offered work at either Columbus, Ohio, or Fort Wayne, Ind., where the heavy repair work will be done in the future.

Ninety employees of the Pennsylvania System were retired from active duty on August 1, under the company's pension plan, and placed upon the "Roll of Honor." Seven of those have been in the employ of the road for 50 years or more each, while 55 have had records of 40 years' service or more. Since the establishment of the Pennsylvania's pension plan, on January 1, 1900, a total of 18,374 employees have been retired under its provisions; of whom 8,262 are still living.

Court news

FEDERAL JURISDICTION EXCLUSIVE AS TO SAFETY OF LOCOMOTIVES.—The federal district court for northern Georgia holds that since Congress has provided for making regulations for the safety of locomotives, this field is exclusively occupied by federal legislation. The carriers have proposed and the commission has not required a rule of inspection providing for automatic firebox doors. Therefore, Georgia Laws of 1924, p. 173, requiring locomotives to be equipped with such doors is held invalid as to locomotives engaged in interstate commerce.—Atlantic Coast Line v. Napier, 2 F. (2nd) 891.

New Santa Fe cars make successful trial trip

The Atchison, Topeka & Santa Fe has just purchased from the Pullman Company and placed in service a dining car and a club lounge car which embody a number of revolutionary changes in design. These cars, which are intended to be operated as a unit, have made a trial trip from Chicago to Los Angeles and return in the California Limited. They depart from conventional design primarily in their interior arrangement which has been planned with a particular view to increasing the efficiency of dining car service. These cars are still considered in the experimental stage and their operation is being watched closely. Patents have been granted to Byron S. Harvey, of the Harvey System, on a number of features of the diner.

Train control installations

The Interstate Commerce Commission has postponed from July 1 to February 1, 1926, the date for fulfilment by the Pere Marquette of the commission's order requiring an installation of automatic train control.

By an order dated July 21 the Illinois Central has been authorized to install automatic train control on its road between Waterloo, Iowa, and Fort Dodge, 100 miles, instead of installing on a division between Chicago and Memphis as was called for by the commission's order of January 14, 1924. This action was taken by the commission on condition that the order shall not result in extending the time within which the order shall be complied with, namely February 1, 1926. The road also must agree that the amendment does not entitle it to claim, in court or elsewhere, any extension of time beyond February 1, 1926.

Cost of locomotive fuel

The cost of fuel coal to the railroads showed a further reduction in April as compared with last year and the earlier months of this year, according to the monthly statement issued by the Interstate Commerce Commission. On the other hand, the cost of fuel oil showed an increase. The average cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I steam railways in April was $2.79 a ton, as compared with $3.19 last April and $2.81 for four months of this year. There was also a reduction in the number of tons used, and the total cost for the month was $20,532,551. The average cost of fuel oil was 3.29 cents per gallon, as compared with 2.80 cents last April and 3.11 cents for four months. The total cost of coal and fuel oil for four months this year was $112,885,814, as compared with $132,244,549 for the corresponding period of last year.

American Locomotive Company to build Whaley constant pressure oil engine

The American Locomotive Company has acquired the exclusive license for the use of the Whaley constant pressure oil engine on rails in the western hemisphere. An engine of this type has recently been built by the Sun Shipbuilding & Dry Dock Company, Chester, Pa. It departs in one essential respect from all other present internal combustion engines in that a piston valve driven by the valve motion of the type commonly used in steam engineering practice opens the cylinder clearance into communication with a receiver of large capacity relative to the clearance, the valve opening synchronizing with the period of the fuel injection. Through this feature it is claimed that the combustion pressure does not rise above the compression pressure, and that an indicator card similar to that of a steam engine is produced. The limiting of the maximum pressure is expected to make possible the production of an engine which will weigh less than 100 lb. per horsepower. The engine just completed is a single acting, four-cylinder, two-cycle machine designed to develop 750 hp.

Meetings and Conventions

American Welding Society

The fall meeting of the American Welding Society will be held on October 21, 22 and 23 at the Massachusetts Institute of Technology, Cambridge, Mass. Exhibits of welding and welded products are to be featured at this meeting and actual demonstrations of welding and cutting will start each morning at 9 a. m. and last until 5 p. m. Five technical sessions are scheduled, at which papers on thermit welding, gas welding of power plant piping, industrial applications of arc welding and economies effected through its use, selection of materials for welding, and spot welding of automobile bodies will be presented.

Machine tool exhibition at New Haven, Conn.

The fifth annual machine tool exhibition will be held in New Haven, Conn., September 8 to 11, inclusive, in conjunction with the sessions of the Machine Shop Practice Division of the American Society of Mechanical Engineers. A diversified number of addresses, papers and discussions of great significance to men concerned with machine tool work of any description, are included in the three-day program. The following papers and the time during which they will be presented should be of particular interest to railroad machine shop men.

Centerless grinding, Wednesday afternoon; cylindrical precision lapping and high speed cutting of brass, Thursday afternoon; round table dinner discussion, Thursday evening of four subjects—namely, inspection methods and precision measurements, power press work, production milling and shop training methods, and Friday afternoon, shop training methods.

Over 100 manufacturers will present the latest developments in the machine tool and accessory equipment showing the advancement made in the machine tool industry during the past year. The exhibit will be held at Mason Laboratory, Sheffield Scientific School of Yale University.

General foremen to meet in September

The twentieth annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, September 8 to 11. Among the interesting topics to be considered are automatic train control; supervision of repairs of special appliances such as boosters, reverse gears, etc.; straight line or spot system of car repairs and routing system to increase locomotive shop output. An additional topic which promises to be of unusual value and provoke a large amount of discussion is entitled "What Can the General Foreman Contribute to Obtain More Ton Miles per Shop Man Hour?"

Program for the Regional meeting of the A. S. M. E. elects officers for 1926

The American Society of Mechanical Engineers will hold a regional meeting on October 5, 6, 7 at Altoona, Pa. As the technical sessions will relate to transportation problems, a more appropriate surrounding for the meeting could not have been selected as the large manufacturing and repair shops of the Pennsylvania System are located at Altoona. Those attending the convention will be favored with the opportunity of visiting the Altoona shops, particularly the new $2,000,000 locomotive repair shop which has been completed within the last two years.

The following program offers to those attending an opportunity of not only seeing the points of interest in the vicinity of Altoona, but of listening to a number of speakers well-known in the railroad world.

MONDAY, OCTOBER 5

Morning and afternoon: Meeting of Council of The American Society of Mechanical Engineers.
Afternoon: Miscellaneous entertainment, such as golf and automobile trips to points of interest.
Evening: Dr. William F. Durand, president, A. S. M. E., presiding.
Conferment of Honorary Membership in The American Society of Mechanical Engineers on General William Wallace Atterbury, vice-president of the Pennsylvania Railroad System.

TUESDAY, OCTOBER 6

Morning: Technical Session.
Afternoon: Trip by special train to Old Portage where party will detrain to see the Old Portage where the incline planes were located by which passengers by canal were taken over the mountains. Special train will return by the Horse-Shoe Curve to Altoona.
Evening: Entertainment in Altoona.

WEDNESDAY, OCTOBER 7

Morning: Technical Session.
Afternoon: Visit to Altoona shops. One of the features will be the operation on the test plant of the first electric locomotive ever tested on it.

TECHNICAL SESSIONS

The entire program for the technical sessions has not been completed, but the following speakers have accepted:

Samuel Rea, president, Pennsylvania Railroad, on American Transportation.
Lawford H. Fry, metallurgical engineer, Standard Steel Work Co., Burnham, Pa., on Influence of the Altoona Test Plant on Steam Locomotive Development.
Samuel P. Bush, president, Buckeye Steel Castings Co., on Engineering Development in the Industries Generally to meet Railroad Wants.
A. J. County, of the Pennsylvania Railroad, on the Growth of a Great Transportation System.

Elaborate arrangements are being made to take care of the ladies and an active committee will be in charge of a series of interesting events for them.

Master Blacksmiths' Supply Men's Association elects officers for 1926

A total of thirteen railway supply companies had exhibits of their products at the twenty-ninth annual convention of the International Railroad Master Blacksmiths' Association, held August 18, 19 and 20, at Cleveland, Ohio. The annual meeting of the Supply Men's Association was held at the Hotel Winton, August 20, at which time the following officers were elected: James A. Murray, Ajax Manufacturing Company, president; A. N. Lucas, The Oxweld Railroad Service Company, vice-president, and Edwin T. Jackman, Firth-Sterling Company, secretary-treasurer. The following is a list of the exhibitors with their representatives:

Ajax Manufacturing Company, Cleveland, Ohio.—Forgings, model of board drop hammer, model of 4-in. Ajax upsetting forging machine, and literature. Represented by J. R. Blakeslee, J. A. Murray, A. L. Guilford, G. Fistoe and W. W. Criley.

Anti-Borax Compound Company, Ft. Wayne, Ind.—Welding compound and literature. Represented by Charles O. Kahre.

Colonial Steel Company, Pittsburgh, Pa.—Crucible for melting steel, specimens of hardened fractures, raw alloy material used in making high-speed steel, specimens of alloy and carbon tool steel fractures, and literature. Represented by F. L. Stevenson.

Crucible Steel Company of America, Pittsburgh, Pa.—Forging machine gripper dies, taps, high-speed steel and Sanderson special tool steel. Represented by F. Baskerfield, A. E. Jones and W. M. Stevenson.

Firth-Sterling Steel Company, McKeesport, Pa.—C. Y. W. bolt and rivet dies, special rivet buster. Represented by Edwin T. Jackman, Willard C. Royce, Thomas A. Larecey, and William A. Nungester.

E. F. Houghton & Co., Philadelphia, Pa.—Railway springs, quenching oils, "draw-temp", hydrocarbonate base black, "quick light A", literature. Represented by Wilbur Wriglet, W. A. Fletcher and J. E. Burns, Jr.

Metal & Thermit Corporation, New York.—Specimens of thermit welding, literature. Represented by Henry D. Kelly and W. H. Moore.

National Machinery Company, Tiffin, Ohio.—Literature. Represented by E. R. Frost, Karl L. Ernst, H. E. Lott and F. J. Mawey.

Oxweld Railroad Service Company, Chicago.—Gas cylinder gages and torches. Represented by William A. Champieux, A. N. Lucas, William Jones, J. W. Boyd and J. W. O'Neil.

Locomotives installed and retired

	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	...	.....	...	.....	.....	.....
Total for 6 months.	927	.....	...	.....	.....	.....

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Locomotive repair situation

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1

Data from Car Service Division reports.

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,279,363	118,653	39,522	158,175	6.9
April 1	2,274,750	125,932	46,815	172,747	7.6
July 1	2,279,826	144,912	49,957	194,869	8.5
October 1	2,304,020	157,455	48,589	206,044	8.9
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1
March 1	2,313,092	141,192	43,855	185,047	8.0
April 1	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June	2,320,261	146,998	48,988	195,986	8.4
July	2,326,734	150,530	47,938	198,468	8.5

Month	Cars repaired: Heavy	Light	Total
December	87,758	2,073,280	2,161,038
March	77,365	2,213,158	2,290,523
June	70,480	1,888,899	1,959,379
September	74,295	1,372,277	1,446,572
December	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347

Data from Car Service Division Reports.

Pilot Packing Company, Chicago.—Packing, Literature. Represented by W. W. Bacon.

Railway Journal, Chicago.—Copies of publication. Represented by E. C. Cook.

Railway Mechanical Engineer, New York.—Copies of publication. Represented by Marion B. Richardson.

Rockwell, W. S., Company, New York.—High and low pressure burners and blast gates, fuel oil appliances, forging and heat treating furnaces, literature. Represented by C. P. Cogswell, D. M. Powers and R. M. Atwater.

Ulster Iron Works, Dover, N. J.—Special staybolt iron, engine bolt iron, drilled hollow staybolts, hammered iron billets. Represented by C. F. Barton, E. W. Kavanaugh, J. C. Campbell and L. E. Hasman.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT FAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 15, 16 and 17, 1925, at St. Paul Hotel, St. Paul, Minn.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Regional meeting October 5-7, at Altoona, Pa. Technical program on transportation problems. Railroad Division. A. F. Steubing. Bradford Corp., 25 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting September 10. A paper on The Lima 2-8-4 Locomotive will be presented by H. W. Snyder, mechanical engineer, Lima Locomotive Works.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention, Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting September 8. Humorist talk on general railroading by Dusty Miller. Dinner party and address by Mr. Miller.

CLEVELAND STEAM RAILWAY CLUB.—F. Ll. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August, at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting, September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The General American Tank Car Corporation has removed its Los Angeles office from the Pacific Finance building to the Bartlett building.

The Union Tank Car Company is constructing repair shops, including a foundry, a machine shop, a power plant and a wheel shop, at Whiting, Ind.

John P. Bourke, eastern sales manager of the Ewald Iron Company, Louisville, Ky., has been elected a vice-president, with office at 33 West Forty-second street, New York City.

The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, has appointed the Federal Machinery Sales Company, Chicago, its sales representative for Chicago and adjoining territory.

Robert L. Nutt, Jr., Norfolk, Va., now represents Robert H. Blackall of Pittsburgh and New York for the sale of the Lawson pipe wrench to railroads in Norfolk and adjacent territory.

Arthur Jackson, 32 Glenholme avenue, Toronto, Ontario, has been appointed sales representative for Ontario and Eastern Canada of the Gibb Welding Machines Company, Bay City, Mich.

Harold Bates has joined the sales department of the Bridgeport Brass Company, Bridgeport, Conn. He will be engaged with matters pertaining particularly to sales organization and research.

Percy M. Brotherhood, formerly first vice-president of Manning, Maxwell & Moore, Inc., has opened an office at 25 Church street, New York City specializing in machine tools and specialties.

The Ohio Locomotive Crane Company, Bucyrus, Ohio, has purchased the Bucyrus plant of the Ohio Steel Foundries, Lima, Ohio, and will remodel the plant for the production of gray iron castings.

The Tennessee Engineering & Sales Company, 510 Burwell building, Knoxville, Tenn., has been appointed agent in part of Tennessee and Kentucky within a working radius of the city of Knoxville, for the Roller-Smith Company, New York.

The Cummings Car & Coach Company has been incorporated, with headquarters at 111 W. Monroe street, Chicago, to manufacture railway appliances. The company has a capital of $200,000, and has issued 1,000 shares of no par value stock. Walter J. Cummings, O. N. Hebner and John T. Giblin are the incorporators.

William J. Miskella has opened an office and laboratory at 1164 West Twenty-second street, Chicago, where he will specialize as a consulting engineer on lacquer, japan and enamel finishing problems. Mr. Miskella was formerly for many years branch manager of the De Vilbiss Manufacturing Company and president of the Lamberson Japanning Company.

The Air Reduction Sales Company, New York City, has purchased the assets and assumed the liabilities of the Gas Tank Recharging Company, incorporated in 1913. The Gas Tank Recharging Company owned and operated acetylene plants at Milwaukee, Wis., and Bettendorf, Iowa; and a carbide plant at Keokuk, Iowa, where they manufactured Sun-Lite brand carbide.

The Lenoir Car Works, Lenoir City, Tenn., has placed a contract with the Converse Bridge & Steel Company, Chattanooga, Tenn., for the construction of car erecting and steel fabricating shops 800 ft. by 125 ft. to take the place of a structure recently burned. The new building, which will be of steel construction, will be completed in 90 days and will be equipped with new machinery.

E. E. Goodwillie, district sales agent of the Bethlehem Steel Company, with headquarters at Chicago, has been appointed steel sales representative on the Pacific Coast, with headquarters in San Francisco, Cal., to succeed Leigh B. Morris, resigned. John F. Hennessy, district sales agent, with headquarters at Cincinnati, Ohio, has been transferred to Chicago, to succeed Mr. Goodwillie.

Brownrigg L. Norton, for the past two years representative at New York of the Western Railway Equipment Company and the Railway Devices Company, of St. Louis, Mo., has resigned the above representation to become sales agent of the Scullin Steel

Company, St. Louis. Mr. Norton's headquarters will be in the New York office of the company at Room 2050, Grand Central Terminal, New York.

The Haynes Stellite Company, New York, manufacturers of metal cutting tools has completed concentration of the company's activities at its plant at Kokomo, Ind. All service in connection with its products will hereafter be extended direct from the plant. The headquarters for administration, sales and engineering activities will be at Kokomo, conducted under the direction of C. G. Chisholm, general manager.

The More-Jones Brass & Metal Company is completing the erection at St. Louis, Mo., of a modern and large plant which will be devoted to the production of brass and bronze castings. The plant will consist of a foundry and machine shop which will provide a total floor area of 157,000 sq. ft. The railroad facilities for the plant will consist of a double spur track for loading and unloading 10 cars and a yard capacity of 20 cars.

The Prentiss Vise Company, New York, has bought the Henry Cheney Hammer Corporation, of Little Falls, N. Y., complete, and will continue to operate the plant at Little Falls with the same personnel that has been there for some time. The Cheney hammers will in future be sold through the Prentiss Vise Company, and the hammer plant will be operated as the Cheney Hammer division of the Prentiss Vise Company.

William McConway, president of the McConway & Torley Company, died on July 28, in St. Francis hospital, Pittsburgh, Pa. Mr. McConway was born in Ireland on February 14, 1842. He came to the United States in 1849 and attended the public schools until he was 12, when he went to work with the Novelty Iron Works. Six months later he entered the service of Olhausen & Crawford, manufacturers of malleable iron castings, remaining with that company until September, 1861, when he entered the United States Army as a private and served through the Civil War; during this service he was promoted to sergeant-major, and in July, 1863, was commissioned a second lieutenant. In September, 1864, he returned to civil life and resumed his employment with Olhausen & Crawford, in 1866 becoming a junior partner of this firm. In 1869 he organized the present business under the firm name of Lewis & Co. and became its general manager. The following year the name was changed to the McConway & Torley Company, and in 1892 the firm was incorporated. Mr. McConway was a pioneer in the development of the automatic coupler. He had served as a director of numerous corporations including that of the Westinghouse Electric & Manufacturing Company. He was also a trustee of the Carnegie Institute and the Carnegie Institute of Technology.

William McConway

The Dearborn Chemical Company, Chicago, is constructing a concrete and brick building as an extension to its plant which will add 10,000 sq. ft. of floor space. New power plant equipment will consist of return tubular boilers, each equipped with automatic feed stokers, and overhead concrete coal bunkers of 150-ton capacity to be filled by a conveyor which will also handle the ashes. The cost of the new plant will be in the neighborhood of $150,000.

The Simplex Semimetallic Packing Company, Pittsburgh, Pa., has acquired all patents, patent rights, trade marks, etc., of the Mason Semi Metallic Packing Company, of Pittsburgh, manufacturers of air pump and piston packings. The Simplex company has discontinued the office of the Mason Packing Company which was located in the Renshaw building and has opened offices in the Oliver building, Pittsburgh, where the business of the company will be conducted.

H. G. Mastin has been appointed representative in the sales department of the Locomotive Stoker Company, eastern district, with headquarters at New York City. Mr. Mastin was born in December, 1887, at Millbrook, N. Y. He served from 1906 to 1918 on the New York, Ontario & Western consecutively as locomotive fireman, traveling fireman and assistant road foreman of engines, and since October, 1918, as mechanical expert for the Locomotive Stoker Company.

The General American Tank Car Corporation, Chicago, has made the following appointments in its tank car sales department: R. J. Sharpe, general western sales manager, with headquarters at Tulsa, Okla.; M. A. Sticelber, sales representative, Tulsa, Okla.; Bennett Epstein, general eastern sales manager, New York City; R. T. Musser, Pacific Coast sales manager, with headquarters at Los Angeles and San Francisco, Cal., and Z. R. Simon, southern sales manager, New Orleans, La.

W. H. Davis, service engineer of the Universal Packing & Service Company, Chicago, has been promoted to general sales manager, with headquarters at Chicago. R. C. Blakslee, of the testing department of the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., has resigned to become a service engineer for the Universal Packing & Service Company. T. P. Williams and J. D. Herr, formerly associated with the National Waste Company at Philadelphia, and W. M. Gibbs, formerly employed by the same company at Chicago, have been appointed service engineers of the Universal Packing & Service Company.

The Bird-Archer Company has opened a new plant in Chicago for the manufacture of boiler water treatment chemicals. The building is of brick and steel construction and with ground owned and available will permit of a 500 per cent expansion. The locomotive anti-foaming compound department is capable with present equipment of turning out 30,000 lb. per day while the department allocated to the manufacture of locomotive anti-scaling and anti-pitting compounds in solid form has a capacity of approximately 20,000 lb. per day. Arrangements for a branch laboratory in connection with the new plant will soon be consummated.

E. J. Tierney, in the service of the mechanical engineer's office of the Missouri Pacific, and George P. Hoffman, general car foreman of the Baltimore & Ohio, at Baltimore, Md., have been appointed district sales managers of the Grip Nut Company, Chicago. Mr. Tierney was born at Attica, N. Y., on October 20, 1888, and was educated in the schools at Attica and Scranton. He entered the service of the Erie Railroad as a water boy and in 1902 went to the Missouri-Kansas-Texas as a machinist apprentice. In 1906 he went to the Missouri Pacific as a machinist. He subsequently served in the same capacity on the Colorado & Southern; Southern Pacific; Chicago, Burlington & Quincy; Galveston, Harrisburg & San Antonio and then returned to the Missouri Pacific as shop draftsman. In 1908 he returned to the Missouri-Kansas-Texas as mechanical draftsman, and was promoted in 1913 to chief draftsman and general inspector of the Missouri-Kansas-Texas lines, which position he left to join the United States Army in France, where he served as a second lieutenant in the engineering corps, assigned to duty in Russia on the Trans-Siberian railroad. He subsequently returned to France where he served in the army for one and one-half years. After his discharge from the army, he returned to the Missouri-Kansas-Texas. In 1920 he was appointed mechanical engineer of the Louisiana & Arkansas, and two years later served in the same capacity with the Midland Valley. He subsequently resigned to return to the Missouri Pacific as inspector, gang foreman and general draftsman, which position he held until his appointment with the Grip Nut Company, as above noted. Mr. Tierney will be located in Chicago. Mr. Hoffman was born at Meyersdale, Pa., on June 28, 1889, and was educated in the public schools and the Tri-State business college in Cumberland, Md. On September 1, 1907, he entered the service of the Baltimore & Ohio as an apprentice in the car department, and in 1912, was appointed supervisor, which position he held until he entered the United States Army, and served two years in the World War with the army in France. He entered the service as a private and was promoted to a commission. After receiving his discharge he returned to America and remained in government service as supervisor of car repairs with the Railroad Administration until he was reappointed general car foreman of the Baltimore & Ohio at Baltimore, which position he resigned to enter the service of the Grip Nut Company. Mr. Hoffman in his new position will be located in the East.

Trade Publications

GEAR CATALOGUE.—Standard stock gear catalogue No. 42, illustrating spur gears, bevels, mitres, internal gears, worms, worm gears and spiral gears, has been issued by the Charles Bond Company, Philadelphia, Pa.

PIPE THREADING MACHINERY.—The Landis Machine Company, Inc., Waynesboro, Pa., has issued catalogue No. 29 descriptive and illustrative of its pipe threading and cutting machines, pipe and nipple threading machines and chaser grinder.

CARBIDE LIGHTS.—Portable carbide lights for night construction are described in a 26-page booklet issued by the Alexander Milburn Company, Baltimore, Md. These lights are particularly suited for contractors, railway mines and quarries.

GALVANUM PAINT.—A color card and a folder descriptive of Galvanum paint have been issued by the Goheen Corporation of New Jersey, Newark, N. J. This paint is applied directly to galvanized iron without the aid of an acid wash or primer of any sort, and no weathering of the metal is necessary.

VACUUM RECORDERS.—Vacuum recorders which operate on the mercury column principle and employ no moving parts, springs or diaphragms, are covered in Bulletin No. 140 recently issued by the Uehling Instrument Company, Paterson, N. J. Full size reproductions of sections of typical vacuum charts show the legibility of this instrument.

OXWELDING AND CUTTING.—"Precautions and safe practices" is the title of a 16-page brochure which has recently been issued by the Oxweld Acetylene Company, Long Island City. This pamphlet has been prepared to provide a brief and practical list of "do's and don't's" so men may understand the precautions and care which are necessary to the safe and economical use of the oxy-acetylene process.

OXYACETYLENE PROCESS.—"Answers to questions about the oxy-acetylene process," a recent publication of the Air Reduction Sales Company, New York, is intended to supply in convenient pocket form some of the information often requested on the principles of the oxyacetylene process, oxygen, care of oxygen cylinders, acetylene, care of acetylene cylinders, equipment, welding, cutting and the company.

CRANES AND FOUNDRY EQUIPMENT.—A black leather binder made up of individual catalogues containing up-to-date information on cranes, cupolas, ladles, tumbling mills, core oven equipment, trucks, turntables and trolley systems, air hoists, elevators, side-blow steel converter, and brass foundry equipment, has been issued by the Whiting Corporation, Harvey, Ill. Thumb index cards are inserted between each of the catalogues which are of letter size, 8½ in. by 11 in.

MOTOR BEARINGS.—"The care of railway motor bearings," publication GEA-60 of the General Electric Company, Schenectady, New York, gives directions for the correct lubrication of sleeve type bearings, considering both armature and axle linings. Brass and babbitt, and iron and babbitt linings are referred to, and instructions are given for rebabbitting bearings. Three photographs showing methods of lubrication, as well as a table showing proper oil levels, are included.

DROP DOOR LOCKS.—A number of application drawings of Wine drop door locks for the guidance of the designing engineer in working out applications to suit various requirements, are contained in an attractive catalogue, No. 41, which has been issued by the Wine Railway Appliance Company, Toledo, Ohio. The catalogue, which contains 40 pages, also features a number of cars equipped with the drop door locks, and vividly shows the method of applying the device and the method of closing the doors on various types of hopper cars.

ABSORBO.—A system of isolation of machinery vibration known as Absorbo, is described in a four-page circular issued by the Cork Foundation Company, New York. This material, adaptable to a large variety of machinery, including power plant apparatus, is a natural cork product made in strips 1½ in. thick, which are set in rigid steel frames with lateral braces under individual machines or under entire areas where machines are set closely together. When properly applied, vibration set up by moving machinery is greatly reduced or entirely eliminated.

STOKERS.—Detroit underfeed stokers of the single retort type are described in an attractive 32-page bulletin, No. 1018, just issued by the Detroit Stoker Company, Detroit, Mich. Among other items of outstanding interest to combustion engineers, the bulletin contains a number of fuel bed cross sections showing conditions of the fire with respect to air distribution and movement toward the dumps. A section of the book is devoted to the application of the stoker to both low and high set boilers and another section shows how twin settings serve very large boilers.

AUTOMATIC CONTROLLERS.—Automatic controllers for temperature, pressure, humidity, liquid level, condensation and other factors which are important to the success of industrial processes, are described in the new catalogue issued by the C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The catalogue resembles preceding editions, but is larger and several more instruments are listed. The importance of automatic control in various industries is stressed in a six-page introduction which is entirely new. An interesting discussion of automatic control problems in a number of industries follows, and many actual cases are cited.

LOCOMOTIVE FEEDWATER HEATERS.—The Superheater Company, New York, has just issued a new catalogue describing and illustrating the theory, construction and application of the Elesco non-contact type of locomotive feedwater heater. The catalogue, which contains 24, 8¼-in. by 11-in. pages, is a treatise on steam production and its utilization in locomotives. With the aid of diagrams accompanied by test, the increase in efficiency of the locomotive through the application of a feedwater heater is explained and what this amounts to in actual dollars and cents under varying conditions. The latest designs are illustrated and many typical installations shown.

SHOP HANDBOOK ON TOOL STEEL.—Tool steel that is purchased from a mill or a warehouse is not, as a rule, a finished product. It is for this reason that Joseph T. Ryerson & Son, Inc., Chicago, has prepared a book for the tool steel user as he is the one who must change the tool steel from a semi-finished to a finished product. For the successful carrying out of this operation certain definite information is necessary. This book, which contains 80 pages with illustrations and tables, presents to the purchasing agent, superintendent or the tool maker a technical subject treated in a non-technical way. The book contains chapters on the following subjects: Choosing the proper steel for the job; heat treatment of tool steel; heating tool steel; heating equipment; forging tool steel; annealing; quenching; tempering; testing tool steel; heat measurement; grinding. This book should be in the hands of every user of tool steel as it contains valuable information which is generally found only in highly technical books.

VALVES AND FITTINGS.—A comprehensive catalogue, No. 83, containing more than 700 pages descriptive of a large variety of valves, fittings and tools, wrought pipe and supplies for steam, water, gas, oil and air installations, is being issued by the Walworth Manufacturing Company, Boston, Mass. The new catalogue is bound in cloth and contains many new devices, among which is included a line of hydraulic steel and iron flanged fittings for 800-lb. cold water working pressure, known as the American hydraulic standard. The new Sigma cast steel fittings and valves are shown in a section which includes also the complete line of drop forged steel fittings. Other items of recent development are pipe hangers and brackets, tested air brake elbows and tees, double disc gate valves for use in oil refinery and pipe line service, an 800-lb. American standard steel and iron gate valve, a new design of yoke top iron body globe, angle and cross valves and steel and iron yoke top globe angle and swing check valves for 250-lb. working steam pressure. Information on a new line of needle point globe and angle valves for fuel oil and gasoline is given, and stop and waste globe valves are listed in ½-in. and ¾-in. sizes. Sections are devoted to specialties and engine and boiler trimmings. A large variety of wrenches and other tools is shown, and there are pages listing drainage and soil pipe fittings, ammonia fittings and valves and heating material. Tables of useful data, as well as telegraphic codes, are included. Certain sizes of screw and flanged fittings and flanges, valves, cocks, etc., have been eliminated from the catalogue, but are carried in the list of special made-to-order items.

Personal Mention

General

F. M. Reed has been appointed motive power inspector, office of master mechanic, of the Eastern region of the Pennsylvania, with headquarters at New York.

W. P. Lambert has been appointed special assistant of the Central of New Jersey, with duties to be assigned by the superintendent of motive power and equipment.

G. S. Webb has been appointed motive power inspector, office of general superintendent of motive power, of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa.

H. M. Warden, superintendent of the locomotive department of the Missouri-Kansas-Texas, has been appointed mechanical superintendent, with headquarters at Parsons, Kans., succeeding M. C. M. Hatch, resigned.

Master Mechanics and Road Foremen

W. H. Prindall, master mechanic of the Connecticut river division of the Boston & Maine, has been transferred to the Southern division, with headquarters at Concord, N. H.

Charles W. Extrand, formerly locomotive engineer, St. Paul Division of the Northern Pacific, has been appointed road foreman of engines, with headquarters at Minneapolis, Minn.

D. J. Ayers, master mechanic of the White Mountains-Passumpsic division of the Boston & Maine, has had his jurisdiction extended to include also the Connecticut river division.

F. A. Graham, traveling engineer of the New York division of the Pennsylvania, has been promoted to assistant road foreman of engines of the same division, succeeding W. M. Rue, deceased.

H. A. Bliss, master mechanic of the Southern division of the Boston & Maine, has been transferred in a similar capacity to the Fitchburg-Berkshire division, with headquarters at East Dearfield, Mass.

Shop and Enginehouse

George H. Massy has been promoted to foreman of the Central of New Jersey at the Elizabethport, N. J., enginehouse.

John J. Martin has been promoted to foreman of the Central of New Jersey at the Phillipsburg, Pa., enginehouse, succeeding George H. Massy.

V. N. Potts, general foreman of the International-Great Northern at Mart, Tex., has been transferred as general foreman to Houston, Tex.

S. J. Starke, roundhouse foreman of the International-Great Northern at San Antonio, Tex., has been promoted to general foreman, with headquarters at Mart, Tex., succeeding V. N. Potts.

H. C. Venter, general foreman, locomotive department, of the Southern Pacific at Sacramento, Cal., has been promoted to superintendent of shops, with the same headquarters, succeeding D. S. Watkins, who has retired.

Purchasing and Stores

W. R. Knauer has succeeded A. G. Follette as supervisor of the stores catalog of the Pennsylvania.

G. B. Hopkins has been appointed division storekeeper of the Gulf & Ship Island, with headquarters at Gulfport, Miss.

G. V. Green has been appointed purchasing agent of the Southern Pacific of Mexico, with headquarters at Tucson, Ariz.

R. J. Gable has been appointed division storekeeper of the Illinois Central at Mattoon, Ill., succeeding A. E. Walters.

F. L. Doss, division storekeeper of the Southern Pacific at Dunsmuir, Cal., has been transferred to Bakersfield, Cal., succeeding J. F. Brown.

E. H. Polk, district storekeeper of the Southern Pacific at West Oakland, Cal., has been transferred to Sacramento, Cal., in place of E. Harty.

J. G. Warnecke, division storekeeper of the Illinois Central at Centralia, Ill., has been transferred to Paducah, Ky., succeeding B. T. Adams.

M. E. Baile has been appointed district storekeeper of the Missouri Pacific, with headquarters at Kansas City, Mo., a newly created position.

A. E. Walters, division storekeeper of the Illinois Central at Mattoon, Ill., has been transferred to Centralia, Ill., succeeding J. G. Warnecke.

J. F. Brown, division storekeeper of the Southern Pacific at Bakersfield, Cal., has been transferred to Ogden, Utah, in place of H. W. Concannon.

H. W. Concannon, division storekeeper of the Southern Pacific at Ogden, Utah, has been promoted to district storekeeper at West Oakland, Cal., succeeding E. H. Polk.

A. J. Mello, purchasing agent of the San Diego & Arizona, has been appointed general storekeeper of the Pacific Fruit Express, with headquarters at San Francisco, Cal.

W. F. Naumann has been appointed division storekeeper of the Illinois Central, with headquarters at East St. Louis, Ill., succeeding W. A. Skinner, who has retired on pension.

E. Harty, district storekeeper of the Southern Pacific at Sacramento, Cal., has been promoted to assistant general storekeeper, with headquarters at San Francisco, a newly created position.

C. M. Barron, purchasing agent of the Cuba Railroad, has been appointed general purchasing agent of the Consolidated Railroads of Cuba, with headquarters at Grand Central Terminal, New York.

Joseph V. Miller has been appointed assistant general storekeeper of the Chicago, Milwaukee & St. Paul. He was formerly western sales representative of the Prime Manufacturing Company, Milwaukee, Wis.

F. J. O'Connor, assistant storekeeper of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has been promoted to assistant purchasing agent, with headquarters at Chicago, succeeding G. R. Cooke, who has resigned.

B. T. Adams, division storekeeper of the Illinois Central, with headquarters at Paducah, Ky., has been promoted to assistant general storekeeper of the Southern lines, the Yazoo & Mississippi Valley and the Gulf & Ship Island, with headquarters at Memphis, Tenn., succeeding W. D. Stokes, deceased.

F. W. Mahl, director of purchases of the Southern Pacific, whose headquarters were recently changed from New York to San Francisco, has now been appointed general purchasing agent, with headquarters in the latter city. He will have general supervision of the purchasing and stores departments of the company.

Car Department

James W. Gibbons has been appointed general foreman, passenger car department, of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kans., succeeding H. J. Neiswinter, retired. Mr. Gibbons was born in St. Louis, Mo., and educated in the grammar schools at Decatur, Ill., his first railroad work being with the Wabash. He has been an employee of the Santa Fe since August, 1887, and for the past two years assistant general foreman. In addition to his duties as general foreman, passenger car department, Mr. Gibbons retains his duties as supervisor of all paint matters of the mechanical department.

Obituary

Allan Bourn, formerly purchasing agent of the Michigan Central, died at Dorset, Vt., on July 13.

W. D. Stokes, assistant general storekeeper of the Illinois Central, with headquarters at Memphis, Tenn., died at Jackson, Miss., on July 20.

R. H. Briggs, formerly master mechanic of the St. Louis-San Francisco at Memphis, Tenn., who retired from active service in 1913, died at Memphis on July 3.